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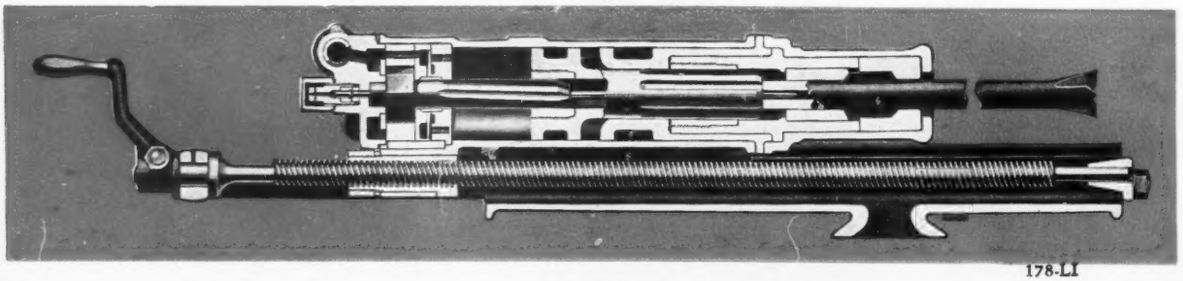

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A. W. ALLEN, *Editor*

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*Assistant Editors:* W. N. P. REED and H. D. KEISER, New York. *Publishing Director:* H. W. CLARKE

## Contents

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**July 13, 1929**

| | |
|---|---|
| Editorials | 41 |
| International Industrial Statistics<br>By MAGNUS W. ALEXANDER | 44 |
| Power-Recording Device Applied to Ore-Crushing Tests | 46 |
| Tractors and Airplanes Defy Canadian Winter Conditions<br>ILLUSTRATIONS | 47 |
| Status of the Magnesite Industry in the United States<br>By J. M. HILL | 48 |
| Mining Copper at Ducktown, Tennessee—II<br>By C. H. MCNAUGHTON | 52 |
| Outline of Future Mining and Metallurgical Operations at Flin Flon Mine, in Northern Ontario | 55 |
| The Use of Letters in Promoting Mine Safety<br>By D. HARRINGTON and C. W. OWINGS | 57 |
| Cost Cutting Innovations | 58 |
| Comment and Criticism | 60 |
| Industrial Progress | 62 |
| Personal Notes | 65 |
| Obituaries | 65 |
| Book Reviews | 66 |
| Mining News | 67 |
| Market and Financial News | 73 |
| *E.&M.J.* Statistics of the Mining Industry | 75 |
| Metal Price Curves | 77 |
| Market Report | 78 |
| Mining Stocks | 80 |
| Service Directory | 41 |
| Searchlight Section | 42-43 |
| What and Where to Buy | 46, 48 |
| Advertising Index | 50 |

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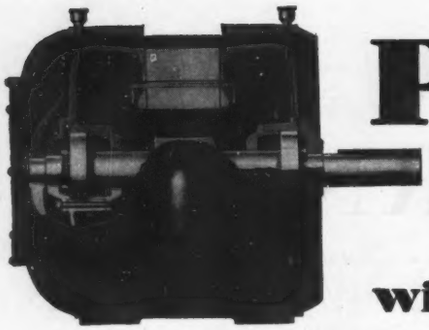

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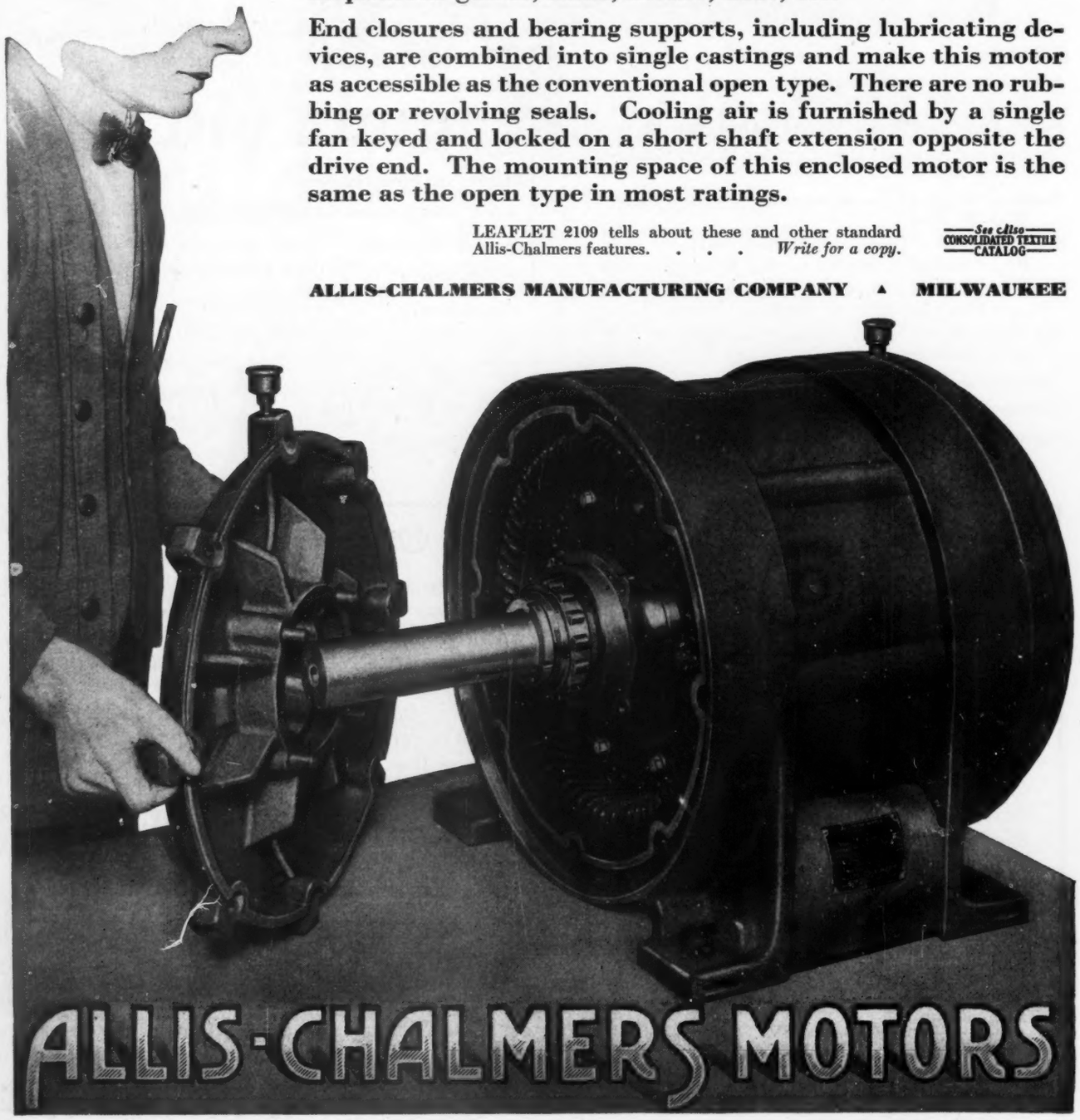

*ENGINEERING AND*
# MINING JOURNAL

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## Science and Business Equally Vital in Progress of Civilization

MODERN BUSINESS ENDEAVOR, like that of scientific pursuit, has become highly specialized. Moreover, outstanding success in business in the United States today requires, in general, as much concentrated attention and training on the part of the devotee as the professions exact from those who would become leaders in the so-called learned callings. Adequate and equal recognition of achievement in the two fields by the country's institutions of learning would therefore seem fitting. Such well-deserved recognition was bestowed recently by New York University, when, at its annual commencement exercises, honorary degrees conferred included the doctorate of laws on Dr. Robert A. Millikan, eminent scientist and director of the Norman Bridge Laboratory of the California Institute of Technology, and the doctorate of commercial science on Mr. James H. McGraw, chairman of the board of directors of the McGraw-Hill Publishing Company.

Each of the recipients occupies a prominent position in his respective sphere of activity; and both, by the results of their individual life work and influence, have benefited their fellow men. Such homage, as rendered by New York University, to the worthy accomplishments of the scientist and business man alike, is laudable. It will inspire the belief that just acknowledgment of meritorious endeavor awaits men in both fields. In the last analysis, the progress made by business will be found to depend, to a large extent, on the progress of science. That of science, similarly, on the progress made by business. Granted equal opportunity for advance and recognition, these two callings will give to civilization its greatest impetus in current times.

## Novel Professorial Advice for the Young Engineer

ROBERT E. ROBERTS, professor of English and history at the Massachusetts Institute of Technology, recently delivered an address before the graduating class of that institution that created somewhat of a sensation. The burden of Professor Roberts' advice to the young graduates at Cambridge was: "Be a snob, marry the boss's daughter, dress, speak and act like a gentleman, and you'll be surprised at the amount of murder you can get away with." Perhaps the most remarkable thing about this advice is the fact that it was given to a group of engineering graduates, rather than to a group of young men about to enter business or those professions that require a more highly developed social life and less practical experience. The general nature of editorial comment on the Robertsian utterances has been decidedly unfavorable, especially in the daily newspapers.

However, careful and unprejudiced consideration of this bit of professional advice, coupled with an honest and non-idealistic realization of current social-economic trends —what may be called the hard facts of life, perhaps— forces the admission that much truth may be found beneath Professor Roberts' pronouncement. His use of the word "snob" is decidedly unfortunate. The term is always derogatory, though capable of varying interpretation.

*Engineering and Mining Journal,* however, has the temerity to interpret his advice for the young mining and metallurgical engineer somewhat as follows: "Strive for advancement by associating with those whom you seek to emulate. Maintain a high standard of self-respect, of physical and mental cleanliness, and do not be content with mediocrity." Not so many years ago the young engineer felt that he must associate with miners and other laborers, on and off the job, to become proficient in his work and to advance in his profession, to attain popularity, and to attract the favorable attention of his immediate superior. Competition is keener nowadays, however, and ability is more likely to be rewarded with promotion when its possessor has taken advantage of his opportunity to become known to all of his superiors, socially as well as professionally.

A long-standing criticism of many of the better-known mining schools has been their adherence to what might be called trade-school practices—to the production of men who could step out of the classroom onto the business end of a rock drill, rather than to provide the training and mold the character of future administrators and executives. The number of prominent executives in the alumni lists of such schools is woefully small, though most of such lists catalog many members in active operating positions. A prominent engineer and educator, head of a Western school of this type, indicated in a recent speech a realization of this condition when he stressed the need for mining engineers with a greater cultural background —perhaps with less trained practical ability to do the many

odd jobs well that command slight wage premiums at the outset. A desirable trend is plainly indicated, and too much thinking of how things were in the "good old days" merely serves to hamper the march of progress.

## Applying Power to Ore-Pulp Classification

WE LIVE in an age of increasing speed; and, thanks to science — paradoxical though it may seem—of decreasing friction, because the rate of progress has demanded that attention be drawn to fundamental considerations of economy and efficiency. In the classification of an ore pulp, however, comparatively little attention has been paid to the possibility of modifying the technique and taking advantage of what opportunity may be found in the use of power as a means of accelerating separation of the component particles—of increasing the velocity of the pulp and its constituents during the separation phase—of giving it a high speed by pump pressure.

The milling of an ore to a particle size suitable for concentration for wet metallurgical treatment necessitates fine or comparatively fine grinding. Particularly if sliming is practiced, the water content of the pulp in the ball mill—with the customary end feed and discharge—must generally be regulated to preserve a consistence unfavorable to classification within the unit, otherwise exposure of balls and liners occurs, and excessive wear is inevitable. In closed-circuit grinding, however, when the pulp has left the mill, it may be diluted to advantage, to aid classification. This dilution insures a better separation of ground from unground particles. Ample facilities exist for the dewatering of both.

In a paper read before the Institution of Mining and Metallurgy last year, Mr. Leonard Andrews made several claims in favor of imparting a velocity to pulp to be classified, by means of a centrifugal pump. One advantage in this modification is seen in the greater ease with which the classified products may be gravitated to their respective destinations, by reason of adequate elevation. An economy of space is evident. A third feature is the ability to effect a classification during the upward passage of the pulp under pressure, by means of what has been termed kinetic elutriation. The principle has been applied with success by devising a vortex chamber, which is arranged in a vertical position, up which the pulp is forced. The combined action of the current, the resulting centrifugal force, and the action of gravity tend to cause a separation of coarse and fine particles. The coarse particles may be returned to the mill, through a dewatering unit, and the fine material sent to the customary thickener.

A classification of a material of uniform composition is a comparatively simple matter, but a metalliferous ore is always complex, particularly in regard to the specific gravities of its component parts. The elutriation of a mixed pulp results in the segregation of smaller particles of a higher specific gravity associated with larger particles of a lower specific gravity. Grading by such a method, moreover, is influenced by the size and shape of the particles. These distinctions and differences become less and less important as the particle size of the mixed pulp is reduced. For instance, a definite concentration of pyritic material may be effected by the use of bowl classifiers, particularly if the finest grinding of the heavier mineral is beneficial to extraction, as has been demonstrated most conclusively in the cyanide plants of Africa and Canada, to mention two countries where this refinement in practice has been adopted on a large scale.

A field exists for screening as well as for hydraulic classification in the preparation of an ore for metallurgical treatment. The principle involved in grinding and screening in one apparatus is sound, and it would be unwise to ignore the fact that excellent work is being done in an effort to solve the problem of dilution adjustment—to secure efficient grinding as well as efficient screening. If applied to closed-circuit work, scope for high velocity classification would seem to be governed to a large extent by the factor of capacity. What advantage, in terms of increased tonnage per unit volume of apparatus, can be claimed as a result of imparting a velocity to the pulp? In view of the trend in the direction of treating larger and still larger quantities of ore, in grinding plants, an answer to this question is of major importance.

## Mother Lode Mining Should Benefit From Geological Investigation

THE "Mother Lode District Folio of California" was published in 1900, F. L. Ransome making the geological investigation and writing the text. Disregarding private engineering reports and incidental accounts in mining papers, nothing of a systematic nature about this interesting gold report appeared until recently, when Professional Paper No. 157, by Mr. Adolph Knopf, was published.

Gold production in 1897 for the four Mother Lode counties—Amador, Calaveras, Tuolumne, and Mariposa —totaled $5,032,911. Mining was active, about 27 different mines being producers. Output in 1926 was $3,048,784. In 1915 it reached the peak—$6,349,772. Economic conditions during and since the war increased the difficulties of gold mining in the region. Low-grade mines had to be shut down. Selective mining helped those of higher grade. As an example, 1,521,847 tons averaging $4.17 per ton was mined in 1915. In 1926, 410,243 tons was mined of an average grade of $7.43 per ton. Only three of the larger properties—Central Eureka, Kennedy, and Argonaut—are now in operation. This indicates the difficulties of the situation and also the resourcefulness of the gold miner, who has kept his industry alive, but on a smaller scale.

Mr. Knopf adds to our geological knowledge of the region, but his most important contribution to the problem is a detailed description of the oreshoots that occur in the vein systems. He states that "although the quartz veins that are inclosed in the Mariposa slate are much alike from mine to mine, especially in Amador County, yet the variety of orebodies along the Mother Lode belt and the complexity of the occurrence of the orebodies in many of the mines are far greater than earlier accounts of the Mother Lode would lead one to expect."

Herein is probably one of the explanations for the conspicuous lack of new and successful mines. The old mines have been progressively explored. Oreshoots that were persistent in depth were followed, but where they

passed into very low-grade ore, without enriched places, the mine was shut down. Mr. Knopf advances the hypothesis that the intersections or junctions of veins are one of the influencing factors that favored the formation of oreshoots. He adds that such intersections occur where veins fill auxiliary fractures in the zone of fracturing that accompanies the main fault. He describes in detail the so-called gray ore, of mineralized country rock, sometimes large and an important source of production. He states that the gray ore occurs in shoots that lie adjacent to quartz fissure veins, in the footwall or hanging wall of the veins, though not necessarily in contact with them.

The future of the Mother Lode lies in the hands of the experienced miner, aided by the skillful geologist. Oreshoots are uncertain in their distribution and in their continuation, but this same is also true of many other mineral deposits. The Mother Lode deserves further study. More knowledge about the occurrence of its oreshoots will contribute to the efficiency of mining.

## Metal Mines Need Efficient Ventilation Systems

FEW metal-mine operators and executives pay particular attention to air flow underground unless forced to do so by unfavorable working conditions. Laws enforcing the adequate ventilation of metal mines are almost nonexistent, despite the presence of many dangerous gases underground, in greater variety than are to be found in coal mines. These comments are made in a bulletin recently compiled by Mr. D. Harrington, chief engineer of the safety division of the U. S. Bureau of Mines, who adds that the recent occurrence of several deaths from heat stroke in the deep mines of the Witwatersrand indicates that the life as well as the efficiency of an underground worker under such conditions must depend on the provision of some efficient method of cooling the air. The fatalities in question occurred in air that was almost saturated, with temperatures between 85 and 91 deg. F. Such temperature and humidity conditions are to be found in a considerable percentage of the working places in many of the deep metal mines of the United States, he states. Although local cooling or conditioning of the air is necessary in some mines, the most effective remedy for bad atmospheric conditions is the continual circulation of a relatively large volume of fresh air from the surface to or past the places where men are working. This is achieved most satisfactorily by the operation of an adequate mechanical ventilation system.

Mistaken opinion in many quarters holds that the only dust which is dangerous to inhale is that composed largely of silica, especially of free silica. The fallacy of this contention was shown by a study of the effect of dust on cement workers, recently made by the U. S. Public Health Service, which indicated that less than 25 per cent of the dust inhaled was silica, and that only a very small proportion was free silica. Cognizance of this finding by the mining industry means that large quantities of any or all finely divided dusts in the air, when breathed for considerable daily periods, are almost certain to be harmful. The best preventives, in Mr. Harrington's opinion, comprise the use of wet drills, the postponment of blasting until the end of the shift or until after the regular shift, and the use of continuous air currents to and past the working regions.

Correct ventilation underground involves the establishment of such control of air currents that the miners may work in safety, with maximum comfort and efficiency, and without impairment of health; also, in controlling the air flow so that the mine workings may at ordinary times be kept reasonably free from harmful gases and dusts, and so that, in time of emergency, as when a fire or an explosion occurs, as large or as little a flow of air as is necessary may be maintained throughout the mine or only in certain parts of it.

Adequate means to control air flow should be an essential feature of every mine ventilating system—obtained always by the installation of mechanically operated fans and such devices as doors, overcasts and regulators. Every mine, large or small, should on the outset be equipped with a fan. Much has been written about natural ventilation, and many claims have been made that in specific mines or parts of mines a sufficient natural air flow exists. As a matter of fact, in few mines is natural ventilation adequate for the safe and healthful occupation of underground workers, even under ordinary conditions. A fire in a mine depending on natural ventilation is soon out of control.

The U. S. Bureau of Mines is to be congratulated on the forceful manner in which the chief engineer of its safety division is insisting that the problem of ventilation in metal mines should be faced and solved. *Engineering and Mining Journal* is appreciative of the opportunity to second these efforts. It is absurd to speak broadly of the prosperity of the mining industry so long as any underground workings lack efficient and adequate ventilation systems. Splendid progress in this direction has been made by some companies at heavy cost, and a greater deflection of attention to accomplishments of this character should stimulate a competitive concern in the attainment of operating efficiency and the reduction of hazard to health and safety.

## Safeguarding the Worker's Money

EMPLOYERS should encourage thrift by providing the opportunity for sound investment. Savings funds may serve for emergency or old age, but complications arising out of temporary financial embarrassment affect the morale of the working force. A study recently published by the National Industrial Conference Board indicates that credit unions for industrial employees, almost unknown in the United States a few years ago, have spread rapidly, and enjoy increasing popularity. Such a union receives the savings of the employee and loans money to him; it is virtually a banking institution.

Legislation has been passed in twenty-seven states governing the formation and operation of such employee associations. The acceptance of the scheme is evidence in support of the position taken by several large banks recently—that financial accommodation to small borrowers not able to supply tangible collateral is a feasible and legitimate banking service.

# INTERNATIONAL INDUSTRIAL

PRODUCTION *capacity in various industries the world over has increased to a point where balanced output, which is the basis for stable industrial activity, has become a paramount world economic problem. Productivity alone creates purchasing power and, hence, all the world's industries could not possibly produce too much, for each product, in effect, in a well-balanced market, should be a demand for other products. Yet it seems the irony of fate that many industries are continually harassed with the problem of overproduction, whereas at the same time poverty is still widespread in many lands, and millions of human beings live in want and even on the brink of starvation. In the last analysis, therefore, the proper co-ordination of production, the proper balancing of the various economic activities, makes possible an economic equilibrium that reflects itself in stable industrial conditions. This, the prerequisite to lasting and well-distributed prosperity, lifts the economic status of all classes. Such co-ordination and balance, however, cannot be accomplished without international industrial statistics.*

IN OUR age, through the intensive and rapid development of means of transportation and communication by land, by water, and by air, nations live in greater economic propinquity than ever before. Whether situated near by or far apart their economic interdependence increases from year to year.

The world at large has made rapid and astounding progress in recent years—in methods of production, in technological procedure and technical invention, in industrial relations, in commercial intercourse and financial co-operation. The charting of that varied international progress, however, has barely passed the stage of a mere beginning, and comparable statistical data on world industrial conditions as yet are decidedly fragmentary.

MAGNUS W. ALEXANDER

International industrial statistics, in the true sense of the word—statistical information produced by systematic international inquiry—are but little in evidence. What international industrial statistics there are consist mainly of co-ordinated national statistical data and, in part, of mere estimates for which the required data in many countries are entirely lacking. In every country the economic activity upon which the population depends is so widely scattered over a large number of separate interests that it has become increasingly clear that the requirements of its control through better knowledge could be met only through some form of co-operative effort.

The first expression of this effort has been in the field of governmental activity in the collection and publication of information. Even before the war, the extension of governmental activity in this respect was notable. This activity has developed enormously, and as a result of the war; and it is so necessary and valuable that its continued extension in the future is certain. Nevertheless, the experience of the last twenty years has shown clearly that such governmental activity in providing basic knowledge for industry guidance has suffered, and probably will continue to suffer, from inherent weaknesses. It is important for the present purposes to note these weaknesses carefully, for progress in the future depends greatly on the way in which they may be met, or compensated by other effort.

In the first place, governmental agencies in many instances have not been able to obtain, and cannot obtain promptly, sufficiently comprehensive information to supply the requirements for the guidance of industry without the prior development of such information through private co-operative effort, or without a system of machinery so costly and elaborate as to be out of proportion to the value of the results. In all countries, the process of taking censuses relating to various aspects of individual activity has been time-consuming and increasingly ex-

# STATISTICS *As An Aid to World Progress*

**Abstract of an address by Magnus W. Alexander, president of the National Industrial Conference Board of the United States of America, delivered at a session of the International Chamber of Commerce at Amsterdam on July 9**

pensive, and the results have usually been so long delayed in publication, and have been so general in presentation, that their practical usefulness to the industrial world has in great part been lost. In addition to statistics that can be obtained only through national sources, it would seem that one of the valuable services that government can render is to record and disseminate information gathered through private co-operative effort to meet specific, practical needs.

In the field of industrial statistics, the basis of governmental activity lies in the development of private co-operative effort, and the greatest service government can render is to stimulate such effort and to aid it in various ways. Those who have been impressed by the development of current statistical information regarding industry and trade in the United States should remember that the work of the government in this field depends to a large extent upon the statistical activities of private trade and industrial organizations and similar bodies, although the censuses of manufacturing and of other industries taken by the government of the United States directly are of great fundamental value. In some instances, as in agriculture, the facts could not be gathered otherwise, because of the lack of adequate private organization in the industry. Indeed, those fields of industry and trade in which the information available is most unsatisfactory are those in which the number of units is large and in which adequate private organization and effort is absent.

Development of trade and industrial associations has taken place largely in response to the demand among business men for a type of information regarding conditions in their own fields of industry and trade, which government could not supply promptly enough or in the form in which it would be most useful. The war revealed clearly another weakness in governmental activity in this field. Intensification of political nationalism and separatism, during and immediately following the war, put a further handicap upon governmental effort to obtain promptly comprehensive, economic information regarding conditions in foreign countries, although this information was even more needed after the war than before, because of the disturbance of the currents of world trade following the conflict.

These observations must not be interpreted as detracting from the useful work performed by many governmental statistical agencies, nor must it be forgotten that in many lines of statistical inquiry the governments alone have the resources or facilities to collect comprehensive data. However eager they may be to extend the scope of statistical inquiries, government statisticians, by force of circumstances, often are followers rather than leaders. They disburse public funds and hence must be cautious to use them essentially for inquiries of proved worth. The field of experimentation thus being largely closed to them, it logically becomes the function of organized industry, by trial and suggestion, to explore the ways for expanding the scope of statistical research and knowledge; and responsibility must rest upon organized industry to obtain, with or without governmental assistance, the information necessary for intelligent operation. In this manner, private effort is frequently the forerunner of governmental action.

To any international gathering of this nature, each delegate brings the experience of his own country, and you naturally expect me to do likewise in suggesting what might usefully be borne in mind in developing international statistical information through such an agency as the International Chamber of Commerce. If the development of statistics of industry in the United States may be briefly characterized, it may be said that they have ceased to be a byproduct of industry, and have become one of its potent instruments. To that development a host of individual efforts have contributed.

Such a development has been possible because less and less are the operations of American industry conducted in the general hope that there will be a market for the product at a profitable price, and more and more is production controlled in the light of trustworthy and timely estimates of changes in market conditions. Only through the foresight and foreknowledge thus afforded can a progressive industrial enterprise cope with the force of competition at home and abroad. But it has become increasingly necessary for the individual concern to pool its knowledge with that of others through co-operative associations in which a great variety of enterprises, large and small, is represented. As a result of this work, there is developing for each industry what may be called an *intelligent* market, in which both producers and buyers are well informed. It is generally believed that the remarkable degree of stability in industry and trade in the United States during the past five or six years can be ascribed in large part to this increased intelligence resulting from better knowledge.

An important element in the development of business statistics is the absence of that spirit of secrecy or fear of publicity which is the earmark of pronounced individualism. Increasingly, American business men have come to realize that they have nothing to lose and everything to gain, along with the general public, from a free and full interchange of information that is not of a

direct competitive character or does not involve secret processes. The American government itself has gone so far as to declare that such interchange, opened to the light of publicity, is the best safeguard of industry and the public against wasteful and predatory competition. The dead hand of tradition and custom may be a formidable obstacle to the fullest development of international information, but it must be overcome in each country, and between countries, if knowledge is to yield the fruit of co-operation and stability which is sought. This reactionary attitude, then, is the first and, perhaps, the most difficult problem which confronts any effort to develop useful international statistical knowledge of industry. In each country associated in this effort a patient and persistent educational process will be needed to teach industry, not only the value of comprehensive trade statistics, but also that they will be of no value if they are treated in a spirit of secrecy and individual unrest as *a weapon against others,* rather than as a tool with which all may work together.

In looking forward to the task of developing better international industrial information we must recognize that, although the first step is to increase the fundamentals of knowledge, it is not enough merely to enlarge the volume of industrial statistics through governmental or private effort. Particularly in those countries where such information is now deficient, the primary task is to build it up to the required quality as well as quantity, and to centralize responsibility for it upon some far-sighted, competent agency representing the industries of the country as a whole. There may be formidable psychological or political obstacles in the way of developing adequate international statistics, but I believe that these obstacles can readily be overcome if the task of conquering them is properly organized. Its organization must be accomplished essentially by the industrialists of the world through co-operative effort among themselves and with their governments; and the International Chamber of Commerce may well stand in the center of the movement. But the central organization will be able to function effectively only if pertinent statistics are nationally collected in an efficient manner.

In view of the foregoing considerations it seems to me that there is need in each country, unless the situation is already adequately met, of a national private organization which would assemble and interpret the economic statistics of the various industries and trades and co-ordinate them into a comprehensive intelligence service for the nation as a whole, co-operating at all times with the statistical services of the government and of other bodies and thus benefiting from them. Such national agencies, similar in organization and using similar procedure, methods, and nomenclature, would be in a position to supply promptly the comparable and authentic information needed for the development of current, comprehensive, international industrial statistics.

## Power-Recording Device Applied to Ore-Crushing Tests

PRIOR to the time the U. S. Bureau of Mines began its studies on crushing and grinding, no accurate method had been devised for determining the amount of power required in crushing an ore to the proper size for efficient treatment by a concentration process or by a metallurgical process. As it was of the utmost importance to the Bureau in its study of ball-mill grinding to determine the power used in the mill, the metallurgists conducting the crushing and grinding studies at the Intermountain Experiment Station, Salt Lake City, Utah, in co-operation with the University of Utah, have developed an accurate power-recording device adapted from one used by Prof. H. E. T. Haultain, of the University of Toronto, for measuring power input to rolls and which directly measures the work applied to the ball mill.

The apparatus is used to determine power to the 1/1000 hp., and is independent of motor efficiency, belt friction, belt slippage or other factors. It is constructed as follows: three tangential springs connect the pulley which rotates the ball mill; hence the greater the ball-mill load the greater the extension of the springs. The distance through which the springs extend is transmitted by a steel tape to an integrating meter. This meter is operated by two friction wheels in contact with a disk revolving at a definite speed ratio to that of the mill. The two friction wheels are connected to the meter through a differential gear, so that when centered on the disk both friction wheels revolve in opposite directions at the same speed and the counter stands still. Any displacement from the center of the disk results in an increased speed for one friction wheel and a decreased speed for the other. This change in speed is transmitted through the differential gear to the counter. By the calibration of the meter at various speeds by means of a Prony brake and static loads on the driving pulley, the meter readings may be converted to horsepower.

This device may be applied to other apparatus where accurate power readings are desired, as is demonstrated by the psychology department of the University of Utah, for investigating the effect of practice or repetition on the case with which certain muscles can accomplish definite types of physical work.

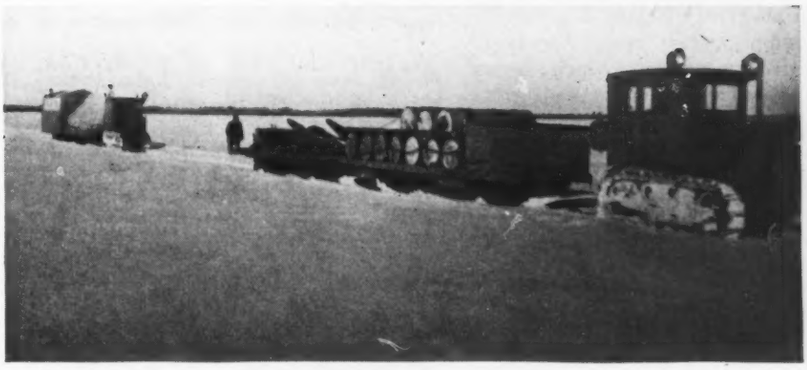
### You Must Usually Spend in Order to Save

*A CORRESPONDENT from the rim of the world—among the high mountains of Colorado—writes interestingly of his climatic problems, but with no apprehension of the results of an ambitious construction program. "The transformers," he says, with a remembrance of intense cold, "the shops, compressors, and crushers are all to be built within the mountain." In this connection we interpose the thought that interesting "cement-gun" work has been done on one property, to face such excavated interiors; and we hope to be in a position to tell our readers about this development in due course. Our correspondent misses nothing in "Engineering and Mining Journal," however. "Living quarters," he adds, "are planned to conform to the specifications and information given in the excellent papers in 'Engineering and Mining Journal' by J. Govan and H. E. Clement (pp. 268, 360. Vol. 127), on 'Economical and Efficient Housing for Hot and Cold Climates.' We are following their advice and using ample insulation."*

# *Tractors and Airplanes Defy Canadian Winter Conditions*

*Left—Caterpillar tractor with its load leaving trading post at Montreal Lake, about 70 miles north of Prince Albert, on its way to Rotten Stone Lake*

*Right—From 40 to 50 deg. below zero! Two caterpillar "thirties" on a 260-mile journey to the site of the Consolidated Mining & Smelting development at Rotten Stone Lake, Saskatchewan*



*Left—On arrival at Emma Lake a tractor load of supplies is transferred to airplanes for the final lap of the long journey to the mining district, where nickel and copper deposits of promise have been discovered*

# *Status of the* Magnesite Industry *in the United States*

By J. M. Hill
*Geologist, Berkeley, Calif.*

FOR THE PERIOD from 1913 to 1926 the average production of crude magnesite in the world was about 500,000 metric tons a year. World data are shown in Table I and Fig. 1. Austria, except for the two years 1918 and 1919, when no production was recorded, has for a long time been a large producer of magnesite suitable for dead-burning. Greece, which before the war supplied a large part of the world's requirements for caustic calcined magnesite, has again nearly reached the 100,000 metric ton a year basis. Canadian output is apparently limited, and her deposits are of importance largely as a reserve supply when prices are high. Czechoslovakia, which began producing in 1921 from deposits that were formerly in Austria-Hungary, has been a fairly consistent shipper of around 75,000 metric tons a year. The British Indian output of caustic calcined magnesite has increased from about 16,000 to 30,000 metric tons, but will probably become less again following the trend of caustic magnesite consumption. Italian production has grown from 600 metric tons in 1913 to 36,000 metric tons in 1919, and in 1926 was 20,000 metric tons, most of which is sold in the dead-burned form. Russia began producing magnesite in 1916, with 72,000 metric tons, and in 1926 produced over 100,000 metric tons. Production of magnesite in the United States attained its peak in 1917, when 287,429 metric tons was produced, but has since averaged a little over 100,000 metric tons a year. Australia has been a constant producer of magnesite for its own use, largely from deposits in New South Wales. The Spanish magnesite deposits have been small producers, but are insignificant as contributors to the world supply. South Africa has constantly supplied its own demands for magnesite, but does not appear in the world picture to any extent.

In 1913 Austria and Greece practically supplied the world's magnesite, but in 1926 the market, although still led by Austria for dead-burned, was divided with Greece, Czechoslovakia, Russia, and the United States, with minor supplies from India and Italy and a small fraction from the rest of the world. Available data indicate that the recent distribution of world output of magnesite has not altered materially, though there may be a tendency for the Grecian and Indian output to decrease rather than increase, for their magnesite is more suitable for caustic than for dead-burning.

*IT SEEMS PROBABLE that use of caustic calcined magnesite for stucco will continue to decline, and that the consumption of this material for minor uses such as floors, bathrooms, tack strips, and similar applications will not be sufficiently large to make possible the continuance of even the present low rate of production. On the other hand, the gradual expansion of West Coast demand for dead-burned magnesite and for the newer high-duty refractories made from magnesite appears probable. The future of the domestic magnesite industry therefore seems to be closely tied in to the development of the iron and steel industry on the Pacific Coast and the expansion of demand for super refractories.*

The first production of magnesite in the United States was in 1886, when several cars or tons of magnesite were shipped to New York from deposits on Cedar Mountain, Alameda County, Calif. For several years following there was a small production from California deposits, but it was not until 1901 that the industry began to take form, and not until 1914 that it was on a large basis. From 1914 to 1917 the industry had its peak production, owing to the necessity for domestic supplies to take the place of foreign magnesite. It was during this period that the Washington deposits in Stevens County came into production. In the 43 years of magnesite mining, 1886 to 1928, California has produced approximately 1,180,000 tons (of 2,000 lb.), or 54 per cent, and Washington, in its thirteen years of operation, 1916 to 1928, has produced 1,000,000 tons, or 46 per cent, of the total United States output of 2,180,000 tons of magnesite.

Table II gives the details of domestic production of crude magnesite and a comparison with the imports of magnesite reduced to a crude basis. The figures for domestic output are taken from "Mineral Resources," published by the U. S. Bureau of Mines, but have been rounded off. The figures of imports are from records of the Bureau of Foreign and Domestic Commerce, and the quantity of calcined magnesite was recalculated to crude, using a factor of 2.1 tons of crude to 1 ton of calcined.

Prior to 1914 the magnesite produced in California was consumed largely by the paper industry, which used caustic calcined magnesite in the digestion of wood pulp to remove resinous material. A small quantity went

**Table I—World Production of Crude Magnesite, 1913 to 1926**

In Metric Tons

| | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | 7,218 | 2,055 | 1,728 | 4,120 | 9,585 | 4,202 | 9,768 | 6,919 | 12,770 | 4,108 | 6,474 | 12,905 | 14,686 | 10,754 |
| N. S. Wales | 7,112 | 2,032 | 843 | 3,821 | 9,337 | 3,419 | 9,413 | 6,578 | 12,465 | 3,424 | 6,228 | 12,697 | 14,257 | 10,428 |
| S. Australia | ..... | ..... | 81 | 169 | 152 | 447 | 277 | 188 | 175 | 585 | 168 | 131 | 357 | 230 |
| Victoria | 106 | 23 | 192 | 30 | 75 | 229 | 78 | 153 | 130 | 99 | 76 | 77 | 92 | 96 |
| W. Australia | ..... | ..... | 612 | 100 | 21 | 107 | ..... | ..... | ..... | ..... | 2 | ..... | ..... | ..... |
| Austria | 422,439 | 279,651 | 78,314 | 81,771 | 10o,783 | ..... | ..... | 120,347 | 160,823 | 281,247 | 180,292 | 156,868 | 164,282 | 162,959 |
| Canada | ..... | ..... | 16,475 | 51,981 | 58,755 | 52,434 | 13,564 | 28,159 | 8,447 | 7,873 | 12,079 | 9,512 | 3,827 | ..... |
| Cyprus | ..... | ..... | 15 | 15 | ..... | ..... | ..... | ..... | 305 | 895 | 284 | 224 | ..... | 83 |
| Czechoslovakia | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 48,578 | 92,942 | 64,030 | 60,044 | 69,532 | 83,135 |
| Greece | 98,517 | 136,701 | 159,981 | 199,484 | 162,938 | 39,340 | 62,408 | 71,870 | 60,132 | 56,642 | 62,552 | 66,727 | 90,828 | 95,638 |
| India, British | 16,458 | 1,707 | 7,569 | 17,922 | 18,493 | 5,947 | 17,401 | 14,577 | 20,338 | 19,582 | 19,748 | 24,854 | 30,095 | 30,950 |
| Italy | 600 | 1,140 | 9,200 | 18,252 | 31,070 | 28,882 | 35,930 | 33,850 | 9,410 | 8,700 | 12,474 | 13,436 | 14,146 | 19,842 |
| Norway | 656 | 938 | 4,017 | 3,499 | 1,004 | 542 | 1,882 | 2,041 | 210 | 738 | 2,359 | 1,976 | 1,699 | 751 |
| Russia | ..... | ..... | ..... | 72,074 | 73,712 | 19,656 | ..... | 17,984 | 14,915 | 10,909 | 18,445 | 33,214 | 75,840 | 103,017 |
| Spain | 958 | 583 | 1,400 | 2,500 | 800 | 1,700 | 120 | 1,214 | ..... | 303 | ..... | ..... | ..... | ..... |
| South Africa | 403 | 519 | 569 | 553 | 709 | 756 | 929 | 1,287 | 1,317 | 997 | 1,387 | 2,001 | 1,823 | 1,826 |
| United States | 8,738 | 10,245 | 27,668 | 140,589 | 287,429 | 210,107 | 141,725 | 275,571 | 43,458 | 50,612 | 133,582 | 108,952 | 109,460 | 121,109 |
| Venezuela | ..... | ..... | ..... | 6,360 | 1,700 | ..... | ..... | 2,000 | 2,450 | ..... | ..... | ..... | ..... | ..... |

into "sorel cement" and carbonic acid gas was also made from magnesite. During this period imported magnesite came mostly from Austria, which supplied about 90 per cent of our imports in dead-burned form, all of which went into the refractory trade. The Grecian deposits supplied purer caustic calcined magnesite for the Eastern flooring trade and paper mills. It was impossible for domestic magnesite to compete with foreign magnesite in the Eastern markets, because of high freight costs.

With the cutting off of foreign supplies in the period 1914 to 1918 the domestic industry was greatly expanded. Many California mines were opened and the high-grade magnesite was shipped east for use in the refractory industry. The Washington deposits were put on a large-scale producing basis to supply dead-burned magnesite. At this time the paper industry was forced to turn to dolomite instead of magnesite, and magnesite has not been used by the paper industry since that change. There was also a considerable expansion in the use of caustic calcined magnesia for floorings, sinks, tiles, and similar purposes during this period.

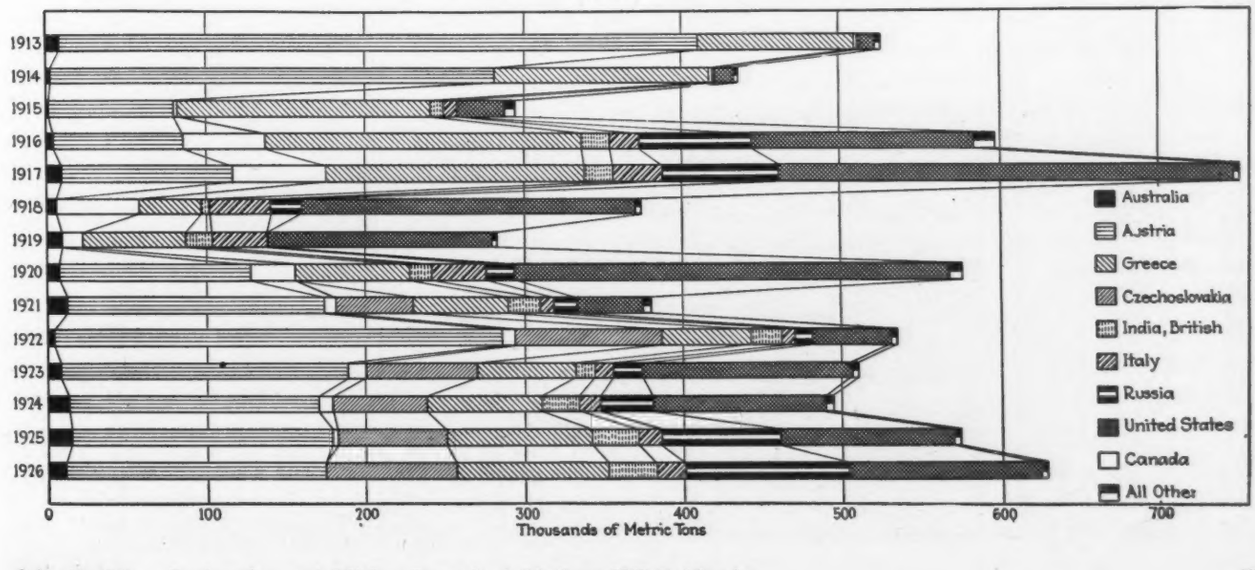
With the close of the war, and with renewed imports, the domestic producers were hard hit. Washington's production of dead-burned dropped to nothing, for its product could not compete with imported Austrian material. Yet in 1923 the Washington industry was revived, but at only about one-sixth capacity. The California miners turned from dead-burning to caustic calcining and until 1926 produced no dead-burned magnesite. The market for caustic was expanded owing to the increased use of material for stucco exterior that developed in the building trade.

### Recent Market Trends Show Marked Changes

As will be seen from Table III marked changes in the market outlook for magnesite have occurred since 1922. The demand for crude magnesite, always small, has been fairly constant at 2,500 tons a year, but the demand for caustic calcined has dropped steadily, until in 1927 it was only about half of the requirement in 1924. Dead-burned magnesite consumption, which followed closely the trend of steel output, has had its ups and downs, but the general trend is upward, owing to development of new outlets for the magnesite refractories and the development of super refractories of fused magnesia which are now finding larger outlets. As will be seen, the prices for imported magnesite, whether it be dead-burned or caustic calcined, are considerably below the prices at which domestic producers of the West Coast can sell their products f.o.b. plant. It is therefore evident that domestic magnesite, except in special cases, can compete in only a limited market in spite of the increased tariffs.

*Crude Magnesite*—The small sales of crude magnesite of both domestic and foreign origin will probably tend to grow smaller rather than larger. Most of the magnesite sold crude was for burning either for its carbon dioxide or by small makers of caustic calcined magnesite. For a while there was a limited market for extremely

*Fig. 1. World Production of Magnesite, 1913 to 1926*



## Table II—United States Production of Crude Magnesite and Imports for Consumption

In Tons of 2,000 Lb.

| | United States Production | | | | | | | | | Imports for Consumption | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | California | | | Washington | | | Total United States | | | Calcined Magnesite | | | | | |
| | | Value | | | Value | | | Value | | Imported | | Equivalent Crude | Crude Magnesite | | Total Imports, Equivalent Crude |
| Year | Tons | Total | Per Ton | Tons | Total | Per Ton | Tons | Total | Per Ton | Tons | Value | Tons | Tons | Value | Tons |
| 1886 | 100 | $1,500 | $15.00 | ..... | ..... | ..... | 100 | $1,500 | $15.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1887 | 600 | 9,000 | 15.00 | ..... | ..... | ..... | 600 | 9,000 | 15.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1888 | 600 | 9,000 | 15.00 | ..... | ..... | ..... | 600 | 9,000 | 15.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1889 | 600 | 9,000 | 15.00 | ..... | ..... | ..... | 600 | 9,000 | 15.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1890 | 600 | 9,000 | 15.00 | ..... | ..... | ..... | 600 | 9,000 | 15.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1891 | 1,500 | 15,000 | 10.00 | ..... | ..... | ..... | 1,500 | 15,000 | 10.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1892 | 1,000 | 10,000 | 10.00 | ..... | ..... | ..... | 1,000 | 10,000 | 10.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1893 | 900 | 9,000 | 10.00 | ..... | ..... | ..... | 900 | 9,000 | 10.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1894 | 1,440 | 12,960 | 9.00 | ..... | ..... | ..... | 1,440 | 12,960 | 9.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1895 | 2,220 | 17,090 | 7.70 | ..... | ..... | ..... | 2,220 | 17,090 | 7.70 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1896 | 1,500 | 10,950 | 7.30 | ..... | ..... | ..... | 1,500 | 10,950 | 7.30 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1897 | 1,140 | 12,650 | 11.10 | ..... | ..... | ..... | 1,140 | 12,650 | 11.10 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1898 | 1,260 | 19,030 | 15.10 | ..... | ..... | ..... | 1,260 | 19,030 | 15.10 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1899 | 1,280 | 18,430 | 14.40 | ..... | ..... | ..... | 1,280 | 18,430 | 14.40 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1900 | 2,250 | 19,350 | 8.60 | ..... | ..... | ..... | 2,250 | 19,350 | 8.60 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1901 | 4,730 | 40,570 | 8.56 | ..... | ..... | ..... | 4,730 | 40,570 | 8.58 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1902 | 2,830 | 19,810 | 7.00 | ..... | ..... | ..... | 2,830 | 19,310 | 7.00 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1903 | 3,740 | 11,220 | 3.00 | ..... | ..... | ..... | 3,740 | 11,220 | 3.00 | 36,767 | $311,396 | 77,211 | 18,009 | $150,002 | 95,210 |
| 1904 | 2,850 | 9,410 | 3.30 | ..... | ..... | ..... | 2,850 | 9,410 | 3.30 | 23,572 | 203,816 | 49,501 | 15,633 | 83,012 | 65,134 |
| 1905 | 3,930 | 15,330 | 3.90 | ..... | ..... | ..... | 3,930 | 15,330 | 3.90 | 62,298 | 595,355 | 130,826 | 7,076 | 63,264 | 137,902 |
| 1906 | 7,800 | 23,400 | 3.00 | ..... | ..... | ..... | 7,800 | 23,400 | 3.00 | 70,657 | 740,585 | 148,330 | 19,739 | 122,908 | 168,119 |
| 1907 | 7,560 | 22,680 | 3.00 | ..... | ..... | ..... | 7,560 | 22,680 | 3.00 | 75,569 | 688,371 | 158,695 | 23,439 | 186,988 | 182,134 |
| 1908 | 6,590 | 19,770 | 3.00 | ..... | ..... | ..... | 6,590 | 19,770 | 3.00 | 64,731 | 655,245 | 135,935 | 19,768 | 81,518 | 155,698 |
| 1909 | 9,470 | 37,880 | 4.00 | ..... | ..... | ..... | 9,470 | 37,880 | 4.00 | 104,474 | 939,014 | 219,405 | 9,818 | 46,005 | 229,223 |
| 1910 | 12,440 | 74,640 | 6.00 | ..... | ..... | ..... | 12,440 | 74,640 | 6.00 | 148,826 | 1,380,731 | 312,535 | 26,001 | 162,069 | 338,536 |
| 1911 | 9,380 | 73,160 | 7.80 | ..... | ..... | ..... | 9,380 | 73,160 | 7.80 | 122,075 | 1,109,770 | 256,358 | 12,974 | 76,097 | 269,332 |
| 1912 | 10,510 | 94,590 | 9.00 | ..... | ..... | ..... | 10,510 | 94,590 | 9.00 | 125,252 | 1,265,339 | 263,029 | 17,905 | 104,326 | 280,934 |
| 1913 | 9,630 | 77,040 | 8.00 | ..... | ..... | ..... | 9,630 | 77,040 | 8.00 | 167,094 | 1,672,565 | 350,897 | 13,240 | 84,911 | 364,137 |
| 1914 | 11,290 | 118,550 | 10.50 | ..... | ..... | ..... | 11,290 | 118,550 | 10.50 | 121,817 | 1,323,194 | 255,816 | 13,354 | 54,677 | 269,170 |
| 1915 | 30,500 | 277,550 | 9.10 | ..... | ..... | ..... | 30,500 | 277,550 | 9.10 | 26,574 | 232,071 | 55,805 | 49,764 | 255,140 | 105,569 |
| 1916 | 154,970 | 1,348,240 | 8.70 | 710 | $5,330 | $7.51 | 155,680 | 1,353,550 | 8.69 | 9,270 | 240,183 | 19,467 | 75,345 | 634,447 | 94,812 |
| 1917 | 211,660 | 2,074,270 | 9.80 | 105,170 | 788,780 | 7.50 | 316,830 | 2,863,050 | 9.04 | 3,966 | 232,601 | 8,329 | 30,277 | 232,105 | 38,606 |
| 1918 | 84,080 | 773,540 | 9.20 | 147,530 | 1,047,460 | 7.10 | 231,610 | 1,821,000 | 7.86 | 13,049 | 824,022 | 40,003 | 5,432 | 103,233 | 45,435 |
| 1919 | 50,020 | 505,200 | 10.10 | 106,210 | 743,470 | 7.00 | 156,230 | 1,248,670 | 7.99 | 9,471 | 270,721 | 19,889 | 6,381 | 103,311 | 26,270 |
| 1920 | 81,780 | 740,110 | 9.05 | 221,990 | 1,664,930 | 7.50 | 303,770 | 2,405,040 | 7.92 | 14,780 | 373,165 | 31,038 | 33,550 | 406,204 | 64,588 |
| 1921 | 47,900 | 510,140 | 10.65 | ..... | ..... | ..... | 47,900 | 510,140 | 10.65 | 6,788 | 250,932 | 14,255 | 51,993 | 595,452 | 66,248 |
| 1922 | 55,610 | 570,000 | 10.25 | 180 | 1,800 | 10.00 | 55,790 | 571,800 | 10.25 | 72,265 | 1,267,622 | 151,757 | 73,331 | 76,283 | 225,088 |
| 1923 | 73,350 | 953,550 | 13.00 | 73,900 | 169,970 | 2.30 | 147,250 | 1,123,520 | 7.63 | 72,955 | 1,022,968 | 153,206 | 5,182 | 44,081 | 158,388 |
| 1924 | 67,240 | 901,020 | 13.40 | 52,860 | 129,510 | 2.45 | 120,100 | 1,030,530 | 8.58 | 64,785 | 1,172,403 | 136,049 | 6 | 85 | 136,055 |
| 1925 | 64,600 | 872,100 | 13.50 | 56,060 | 560,600 | 10.00 | 120,660 | 1,432,700 | 10.22 | 68,395 | 1,160,830 | 143,630 | 487 | 6,382 | 144,117 |
| 1926 | 53,940 | 604,130 | 11.20 | 79,560 | 596,700 | 7.50 | 133,500 | 1,200,830 | 8.92 | 90,293 | 1,438,765 | 189,615 | 608 | 6,555 | 190,223 |
| 1927 | 43,750 | 507,500 | 11.60 | 77,740 | 583,050 | 7.50 | 121,490 | 1,090,550 | 8.98 | 59,261 | 946,361 | 124,448 | 856 | 8,574 | 125,304 |

pure magnesite for the preparation of special refractories and metallic magnesium, but the makers of metallic magnesium are now using other raw materials, which, being byproducts, are much cheaper than high-purity hand-sorted magnesite, and the special refractory is no longer needed. So that market has disappeared.

*Caustic Calcined Magnesite*—Sales of caustic calcined magnesite decreased steadily from 28,470 tons in 1923 to 13,890 tons in 1927, and were probably lower than the last-named figure in 1928. Imports, on the other hand, increased from 11,229 tons in 1923 to 17,075 tons in 1925, but afterward declined to 9,495 tons in 1927. Consumption of caustic calcined declined from 42,654 tons in 1924 to 23,385 tons in 1927, a drop of over 42 per cent in three years. This is attributable primarily to the fact that the use of magnesia stucco has fallen into disrepute, not because the material is bad, but because the average mechanic will not take the trouble to use it in the proper way. The selling point of superior waterproofing qualities of magnesia over portland cement has been discounted in the last three years. There is now almost universal feeling in the building trades that a portland cement stucco is safer than magnesia cement, because of the fact that the mechanic has fewer oppor-

## Table III—United States Sales, Imports and Apparent Consumption of Magnesite, 1922 to 1927

In Tons of 2,000 Lb.

| Year | Domestic Sales | | | Imports for Consumption | | | Apparent Consumption, Short Tons |
|---|---|---|---|---|---|---|---|
| | Short Tons | Value | Price per Ton | Short Tons | Value | Price per Ton | |
| **Crude Magnesite** | | | | | | | |
| 1922 | 1,300 | $13,330 | $10.25 | ..... | ..... | ..... | ..... |
| 1923 | 6,020 | 78,260 | 13.00 | 5,182 | $44,081 | $8.51 | 11,202 |
| 1924 | 1,570 | 20,410 | 13.00 | 6 | 85 | 14.17 | 1,576 |
| 1925 | 2,090 | 26,290 | 12.58 | 487 | 6,382 | 13.10 | 2,577 |
| 1926 | 1,540 | 17,440 | 11.32 | 608 | 6,555 | 10.78 | 2,148 |
| 1927 | 1,800 | 17,130 | 9.52 | 856 | 8,574 | 10.02 | 2,656 |
| **Caustic Calcined Magnesite** | | | | | | | |
| 1922 | 21,990 | $813,630 | $37.00 | ..... | ..... | ..... | ..... |
| 1923 | 28,470 | 1,035,740 | 36.38 | 11,229 | $315,585 | $28.10 | 39,699 |
| 1924 | 26,520 | 883,120 | 33.30 | 16,134 | 378,200 | 23.44 | 42,654 |
| 1925 | 23,900 | 782,700 | 32.75 | 17,075 | 414,752 | 24.29 | 40,975 |
| 1926 | 18,580 | 596,370 | 32.10 | 14,830 | 330,131 | 22.26 | 33,410 |
| 1927 | 13,890 | 452,810 | 32.60 | 9,495 | 223,028 | 23.49 | 23,385 |
| **Dead-Burned Magnesite** | | | | | | | |
| 1922 | 2,200 | $51,260 | $23.30 | ..... | ..... | ..... | ..... |
| 1923 | 34,410 | 671,000 | 19.50 | 61,726 | $707,383 | $11.46 | 96,136 |
| 1924 | 29,830 | 787,500 | 26.40 | 48,651 | 794,203 | 16.32 | 78,481 |
| 1925 | 29,110 | 923,960 | 31.74 | 51,320 | 746,193 | 14.54 | 80,430 |
| 1926 | 42,540 | 1,089,690 | 25.62 | 77,108 | 1,128,823 | 14.64 | 119,648 |
| 1927 | 40,210 | 990,300 | 24.63 | 49,873 | 727,881 | 14.59 | 90,083 |

tunities to spoil the job. All of which means that the demand for caustic calcined cement will probably continue to decrease. It seems highly improbable that the paper industry will again use magnesite, in view of the abundant supplies of cheap dolomite which they learned to use successfully. The uses of caustic calcined magnesite at present are limited to flooring, sinks, bathrooms, floor sleepers, and tack strips in concrete construction jobs, and a few minor applications.

Should the new demand for carbon dioxide as a refrigerant increase, as some believe to be inevitable, magnesite may again be burned for its gas content, but such a tendency improbably would result in an increased market for the byproduct caustic magnesia.

DEAD-BURNED MAGNESITE—Since 1922 the market for dead-burned magnesite expanded from less than 100,000 tons to nearly 120,000 tons in 1926, over half of which was supplied by imported material, as was natural in view of the location of the market almost entirely east of the Mississippi River. In spite of this market advantage for the foreign dead-burned magnesite, the domestic industry has been able to expand, and it will probably continue to expand, though perhaps at a slower rate than the owners of properties would desire.

The iron and steel industry on the Pacific Coast has grown remarkably in the last eight years, and should continue to grow. This growth will make possible the rejuvenation of the California and Washington magnesite industry, for in a West Coast market it does not seem probable that European magnesite could compete with domestic supplies. Dead-burned dolomite is and will continue a formidable competitor of dead-burned magnesite in the East, but for the West Coast there is some doubt that dolomite will be able to take the market from magnesite as it may in the Eastern states.

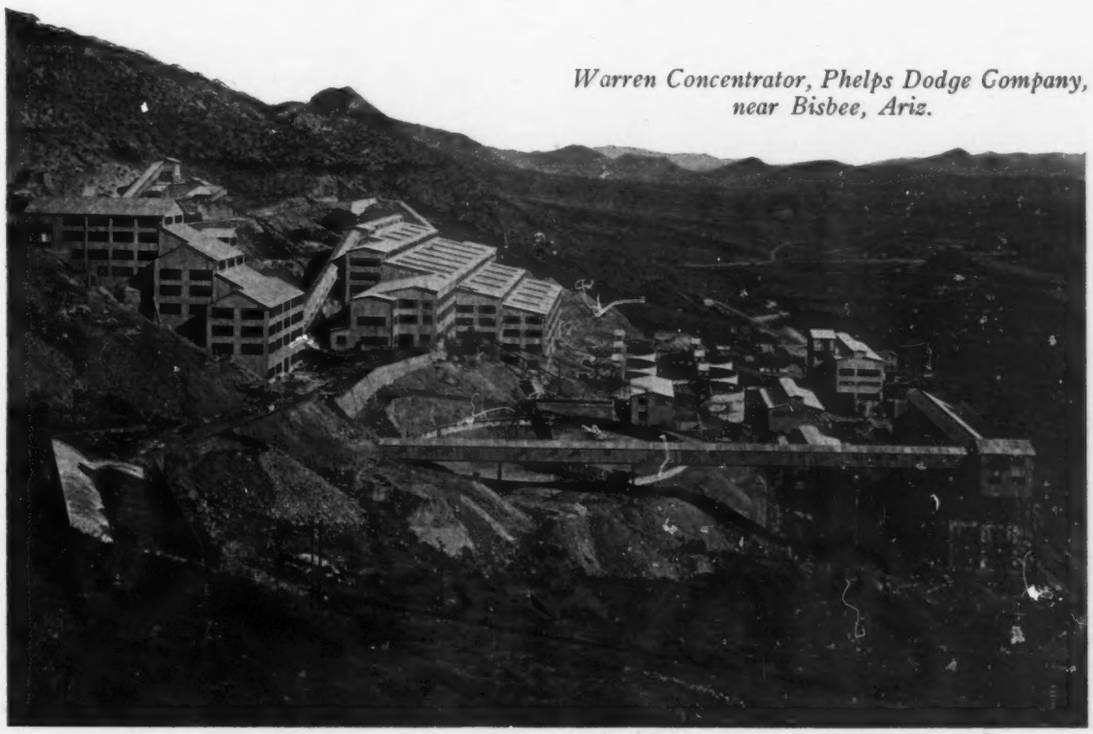
## Vibratory Screen Motion Found Most Efficient

EXPERIMENTS have recently been carried out by A. W. Fahrenwald and S. W. Stockdale, under a cooperative agreement among the U. S. Bureau of Mines, University of Idaho, and the Idaho Bureau of Mines and Geology, to determine the effect of different types of sieve motion on screening efficiency. The results are published in Serial No. 2933, Reports on Investigations, U. S. Bureau of Mines.

In this study of the relation of sieve motion to screening efficiency, five types of sieve motion were investigated. Primarily, thin beds, not more than one sand grain deep, were studied. Several experiments using thick beds more than one sand grain deep were made. Crushed and sized white quartz and galena sands were the products tested. The sand sizes studied were 14/20 to 65/100 mesh prepared with standard Tyler sieves. The vibrated or agitated sieve was in all cases the intermediate Tyler sieve of the $4\sqrt{2}$ series.

Under the conditions of these experiments, the highest screening efficiency was obtained when the sieve was agitated by a high-frequency vibratory motion. The other types of shaking investigated, in order of decreasing efficiency, were: horizontal jarring, produced by tapping the screen with one hand while holding it with the other; vertical jarring, produced in the same way; horizontal rotary motion combined with vertical jarring; and horizontal rotary motion without jarring.

With the vibrator-type motion, a critical amplitude and frequency of vibration at which maximum screening efficiency is obtained exist for each size and density of sand screened. The amplitude of vibration for maximum screening efficiency is directly proportional to the size of sand screened. The frequency of vibration for maximum screening efficiency is inversely proportional to the size of sand screened. The rate of screening for thick beds is less than for thin beds.



*Warren Concentrator, Phelps Dodge Company, near Bisbee, Ariz.*

# Mining Copper at Ducktown, Tennessee—II

By C. H. Mc NAUGHTON[1]
*Mine Superintendent,*
*Tennessee Copper & Chemical Company.*

*IN PART I of this article, published in last week's issue, a brief history of the mining operations now conducted in the Ducktown Basin by the Tennessee Copper Company was presented, followed by a short description of the geology and mineralogy of the deposits. The remainder of the first installment was devoted to a detailed description of the mining and development methods used. The article is completed in this issue.*

*Compressors*—The air-compressor plant is situated at McPherson shaft. There are three 2,500 cu.ft., electrically driven, two-stage air compressors maintaining a pressure of 100 to 110 lb. at the plant. This gives a pressure of about 90 lb. at the drills. This plant furnishes the air for Burra Burra mine, the Eureka mine, and the high-pressure air at the flotation plant. The air is metered to each operation, and the cost of compressing the air is pro-rated to each on the basis of air actually consumed. Each foreman is held responsible for the air consumed in the operations under his direction. The meters were introduced as part of a drive to reduce air consumption. Prior to this drive all three compressors were required at times to maintain pressure. At present only one compressor is employed, and the rate of ore production is 40 per cent greater than formerly.

*Drills*—For all drifts, crosscuts, and other horizontal drilling a medium weight Leyner-type drifting machine is employed. With this type of drill 1¼-in., hollow, round steel in lengths of 30 in. to 10 ft. 8 in. is used. Steel is made up in 1-ft. changes, but 2-ft. changes are employed in drilling. The double taper (5 to 14 deg.) cross bit is standard at this mine. Starters have a gage of 1⅞ in., with $\frac{1}{16}$ in. decrease in gage for each change of steel. Thus, the bit on a 10-ft. steel has a gage of 1⅜ in.

For all benching, sinking, and other down holes, medium-weight hammer drills equipped with plugger shells are employed. These machines use ⅞-in. hollow hexagon, collar-shank steel in lengths of 30 in. to 10 ft. 6 in. over all. The double-taper cross bit is employed with $\frac{1}{16}$-in. change in gage for each change in steel, starting with 1¾-in. gage.

In raising and other up holes, hand-rotated stopers are employed with 1-in. hollow hexagon steel having double-taper bits of the same sizes as those for the jackhammers.

Drifters and stopers are run wet and jackhammers dry.

The deep-hole drills are of the heavy drifter type with independent, reversible rotation. These drills employ 1¼-in. hollow round steel with forged threads, made up in 3- and 6-ft. lengths and with outside couplings. These drills are mounted on a crossbar secured to two columns with universal clamps. The double-taper cross bit is used, starting with 3¾-in. gage. Twenty-five gage changes are used between 3¾ and 2¼ in. In medium ground and for holes not more than 100 ft. in depth each bit is run until the hole size is down to that of the next gage. In harder ground, or for larger holes, as many as three bits of each gage are employed.

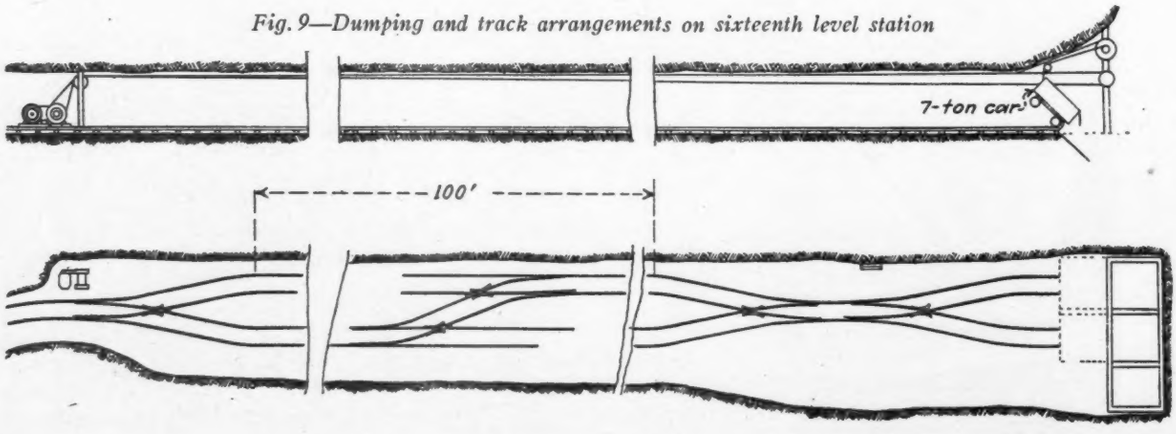
These machines do not work satisfactorily on flat or down holes. They give best results on holes above 15 deg. from the horizontal. Their operation requires men of exceptional ability. The drills are always run wet; the water is introduced through a swivel connection in the side of the first drill rod, which is of special forged construction.

The crew consists of two men, a runner and a helper, who drill on the average about 25 ft. per shift. Total cost of deep-hole drilling is 80c. per foot, including labor, air, shop work, and steel.

All steel is handled in a central shop with two sharpening machines and three oil-fired forges. The forges are equipped with pyrometers, and an excess of oil is used to produce a minimum of oxidation and resultant

[1]Also one of the consulting engineers, U. S. Bureau of Mines. Printed by permission of the Director, U. S. Bureau of Mines.

*Fig. 9—Dumping and track arrangements on sixteenth level station*



scaling of steel. It has been found that best over-all results are obtained by careful work on the steel rather than by endeavoring to obtain high output per sharpener.

*Underground Transportation*—Locomotive haulage is employed on all mine levels. The production is handled by four- and six-ton trolley locomotives with cable-reel attachment and for development work one- and two-ton storage battery "trammers" are used. Main-haulage tracks are laid with 40-lb. rails. All tracks are 24-in. gage.

Seven-ton end dump, steel cars equipped with roller bearings are employed on the sixteenth level, dumping through chute or slide directly into seven-ton skips at Burra shaft. These cars are 5 ft. wide, 45 in. high, and 9 ft. long and are equipped with journal springs. The cars are built in the company's shops at Copperhill.

Storage for loaded and empty cars is provided at the shaft bottom, with convenient crossovers and turnouts. The cars are moved by means of an overhead continuous rope system, driven by a small electric hoist, and are dumped by power from the car mover. The skip riders, two in number, move and dump the cars without other assistance. Fig. 9 shows the arrangement at the shaft bottom.

On the fourteenth level, five-ton Granby-type cars are employed, which dump into a storage pocket or directly into the skip by means of an air jack. The storage pocket has a capacity of 400 tons, and discharges into a measuring pocket. Discharge from the storage pocket into the measuring pocket is regulated by a vertical, undercutting gate operated by a double-acting air jack. The measuring pocket discharges into the skip through an air-operated door.

On the twelfth level both Granby cars and two-ton rocker cars are in use. The former are used for loading ore from pull holes and the latter for hand loading. These cars dump either into a pass leading to the fourteenth level pocket or directly into the skip, depending upon the kind of ore being handled.

On the tenth level and above, four-ton end-dump cars are employed, which dump either into pockets and ore passes leading to pockets or directly into skips, depending upon the kind of ore being handled.

The necessity of keeping the two grades of ore separate on each level is responsible for the two methods of handling as above described. Pockets are situated in the shaft below the sixth, tenth, and fourteenth levels; these pockets and the passes from the other levels have a combined storage capacity of 7,000 tons.

The hoist at Burra shaft is a double-drum geared hoist driven by a 400-hp., 2,300-volt, slip-ring motor. The drums are 6 ft. in diameter by 4 ft. face, grooved for 1¼-in. rope. Three layers of rope are run on the drum. Hoisting speed is 700 ft. per minute. The hoist was installed in 1917. McPherson shaft hoist is a duplicate of that at Burra.

The skips are equipped with manganese-steel wheels and liner plates.

*Percentage of Extraction*—Eighty-five per cent of the ore is extracted, with a dilution of about 5 per cent.

*Stoping Methods Compared*—In comparing the shrinkage method with the sublevel method of stoping, it may be stated that: (1) Sublevel stoping is safer because of the fact that the men are not out under a wide back, but are always under solid ground, which can be and is tested daily. (2) The total breaking cost is less in sublevel stoping than in shinkage stoping, largely because the ore is broken finer from the solid with less secondary breaking in the sublevel stopes; in the shrinkage stopes large slabs come down, which must be drilled and blasted, but often they fall in such a position that it is dangerous to go out under the stopes to break them up. (3) The drawing of the ore from sublevel stopes as compared to shrinkage stopes can be concentrated at fewer pull points to obtain the same rate of output, so that increased pulling and haulage efficiency results. (4) In sublevel stopes a greater percentage of the ore is recovered. In the shrinkage stopes a considerable amount of ore was often left on the footwall because of minor folding, and this ore can be recovered only by open stoping in which the footwall is exposed throughout the operation. (5) In the sublevel stopes very lean or barren parts of the orebody are left as pillars; this is usually difficult to do in shrinkage stopes. (6) More development and stope preparation are required for sublevel stoping than for shrinkage stoping. The difference, however, is not as great as might first appear, because shrinkage stopes require closer spacing of pull holes. Furthermore, it was found advisable to carry footwall or pillar raises in addition to cribbed manways through the broken ore for access to the shrinkage stopes.

**Table II—Labor Costs Per Ton, 1928**

| | Stope Drilling | Blocking and Loading | Total |
|---|---|---|---|
| Sublevel stoping | $0.094 | $0.079 | $0.173 |
| Shrinkage stoping | 0.128 | 0.144 | 0.272 |
| Ore pillars under old shrinkage stopes | 0.040 | 0.251 | 0.291 |
| Floors and pillars | 0.039 | 0.135 | 0.174 |

In comparing the figures in Table II it must be borne in mind that the shrinkage stoping was in somewhat narrower orebodies and included more hand loading than did the sublevel stoping. Ore from pillars under old shrinkage stopes was loaded entirely by hand and was also hand sorted at the face.

### Wage Contract, and Bonus System

All development work, with the single exception of the long crosscut to the Eureka mine, is driven on contract. The blocking (blockholing) and loading are done partly on contract and partly on day's pay. Thirty-nine per cent of the total shifts under this classification in 1928 were paid on the contract basis. Thirty per cent of all stope drilling was done on contract. All other mine labor was paid according to standard daily wage rates.

*Development*—Drillers in standard 8x8-ft. drifts receive a price of $5.50 per foot with a 50c. variation either way for very hard or very soft ground. The ground classification is determined at the end of each pay period by the mine engineer, who is himself an experienced drill runner. The company pays for mucking these headings in the manner described later under "loading." Sublevel drifts are contracted at the following rates: $6 per foot for the first 50 ft. from dump point; $6.50 per foot for distances of 50 to 150 ft. from dump. Fifty cents is added to or taken from these prices for hard and soft ground, respectively. The prices named cover drilling and mucking labor and dynamite. The drillers receive 60 per cent and the muckers 40 per cent of the net earnings.

For raises driven by two men, which is the usual practice, the price per foot ranges from $5.25 for the first 25 ft. above the level to $8.50 per foot for distances 200 ft. or more from the level. Price changes are made every 25 ft. A 25c. variation from these prices is made for hard and soft ground.

**Table III—Company Rates and Contractors' Average Earnings for Principal Classifications, 1928**

| Classification | Company Rate per Shift | Actual Contract Earnings per Shift |
|---|---|---|
| 1. Drillers: | | |
| (a) Development | $3.92 | $7.17 |
| (b) Stoping | 3.92 | 6.06 |
| 2. Trammers (loading) | 3.60 | 4.97 |
| 3. Timbermen | 3.72 | .... |
| 4. Motormen | 3.92 | .... |
| 5. Skip conductors | 4.88 | .... |
| 6. Hoist engineers | 4.88 | .... |

*Stoping*—Drilling in stopes is contracted at a price of 7 to 10c. per foot of hole drilling; the price is varied according to the hardness of the ground. It is fixed for each stope and is altered only occasionally as conditions change.

*Loading*—Loading includes blockholing on grizzlies, loading cars from grizzlies, and hand loading from drifts, stopes, and robbing. The men employed on this work are shifted from one job to another as occasion demands. Payment is made on a per-ton basis; the tonnage is figured from the car count.

**Table V—Summary of Costs Per Ton in Units of Labor, Power and Supplies**

Mine: Burra Burra. Mining methods: Sublevel stoping and shrinkage stoping
Tons of ore hoisted, 473,292

| | Development | Stoping | Total |
|---|---|---|---|
| **A. Labor (man-hours per ton):** | | | |
| Drilling and blasting | 0.137 | 0.216 | 0.353 |
| Blocking | ..... | 0.132 | 0.132 |
| Mucking | 0.105 | 0.258 | 0.363 |
| Transportation | ..... | ..... | 0.205 |
| General | ..... | ..... | 0.089 |
| Supervision | ..... | ..... | 0.100 |
| Surface labor applicable to underground | ..... | ..... | 0.074 |
| Total man-hours per ton | 0.242 | 0.606 | 1.316 |
| Tons per man-shift | ..... | 13.20 | 6.08 |
| Labor per cent of total cost | ..... | ..... | 65.6 |
| **B. Power and supplies:** | | | |
| Explosives (pounds per ton) 40 per cent ammonia | ..... | ..... | 0.755 |
| Timber (board-feet per ton) | ..... | ..... | 0.610 |
| Total power (kilowatt-hours per ton) | ..... | ..... | 7.92 |
| Other supplies in percentage of total supplies and power | ..... | ..... | 42 |
| Power and supplies — percentage of total cost | ..... | ..... | 34.4 |
| **C. Percentage of total cost** | 20.2 | 79.8 | 100.0 |

Figures for development are based on total mine output and not on ore from development headings only.
Drilling and blasting includes labor employed in sharpening steel on surface. Mucking includes all loading of cars.

Prices paid range from 4 to 30c. per ton, depending upon the loading method, amount of blockholing required, and car service.

Labor for blocking and loading from grizzlies is paid for at the rate of 4 to 7c. per ton. The 7c. rate was paid at the first grizzlies installed, where storage was provided below the grizzly and the ore had to be pulled through a chute. On account of the blocky nature of the ore, it tended to wedge in the chute, and almost as much labor was required to pull the chute as to block the ore through the grizzly.

Hand loading from development drifts is paid for at rates varying from 20 to 30c. per ton, depending upon the material handled (waste or ore) and length of hand tram.

The actual price paid for loading is set for each job and place upon recommendation of the mine foreman and authorization by the superintendent.

*Ventilation*—Natural ventilation is good except in dead ends, where small electrically driven blowers with flexible tubing are employed. The flexible tubing is being discarded in favor of 16-gage steel pipes 8 and 12 in. in diameter with stovepipe joints.

*Fire Hazards*—Very little timber is employed in the mine, and all scrap timber is brought to surface for disposal. Although the ore contains 15 to 30 per cent sulphur, it has never caught fire and has shown no signs of heating. Electric wiring is installed in accordance with best practice for prevention of shorts, and undergoes periodic inspection.

**Table VI—Detail of Costs in Units of Labor, Power and Supplies**

| | Development | | |
|---|---|---|---|
| | Drifting | Drifting | Drifting |
| Size of excavation | 8 by 8 ft. | 4 by 6 ft. | 5 by 5 ft. |
| Timbered or not | No | No | No |
| Physical properties of rock | Medium drilling, but rather difficult to break | | |
| **A. Labor (man-hours per foot):** | | | |
| Breaking (drilling and blasting) | 3.3 | 3.3 | 4.4 |
| Mucking and hand tramming | 3.3 | 2.9 | .... |
| Total labor (man hours per foot) | 6.6 | 6.2 | 4.4 |
| Feet per eight-hour man-shift | 1.21 | 1.30 | 1.83 |
| **B. Power and Supplies (per foot):** | | | |
| Explosives (pounds per foot) | 11.2 | 9.5 | 8.8 |
| Power (kilowatt-hours per foot) | 36 | 30 | 27 |
| **C. Labor (percentage of total cost):** | 55.7 | 55.0 | 50.5 |
| Power and supplies (percentage of total cost) | 44.3 | 45.0 | 49.5 |

Labor for sharpening steel and advancing air lines is included in figure for power and supplies.
Haulage and hoisting of development muck and loading of raise muck are not included in development figures.

*Safety and First Aid*—The company employs a safety engineer on full time at the mine. This engineer gives first-aid training to regular classes, makes inspections, checks engineering work for safety, and conducts educational work by personal contact and classes. Since safety has been recognized as a major problem accidents have decreased markedly in frequency and severity.

## Operating Costs

Details of operating costs are given in Tables IV, V, and VI.

**Table IV—Underground Mining Costs Per Ton Ore Hoisted in Burra Burra Mine, 1928**

| | Labor (a) | Supervision | Compressed Air, Drills and Steel (b) | Power Cost | Explosives | Timber | Other Supplies | Total |
|---|---|---|---|---|---|---|---|---|
| Development | $0.149 | ..... | $0.037 | ..... | $0.043 | ..... | ..... | (c) $0.229 |
| Mining | 0.131 | ..... | 0.034 | ..... | 0.049 | ..... | $0.002 | 0.216 |
| Blocking | 0.065 | ..... | 0.017 | ..... | 0.034 | ..... | ..... | 0.116 |
| Transportation (underground) | 0.231 | ..... | ..... | $0.035 | ..... | $0.024 | 0.096 | 0.386 |
| General underground expense | 0.045 | $0.085 | ..... | ..... | ..... | ..... | 0.015 | 0.145 |
| Surface expense (directly applicable to underground operation) | 0.033 | 0.005 | ..... | ..... | ..... | ..... | 0.005 | 0.043 |
| Totals | 0.654 | 0.090 | 0.088 | 0.035 | 0.126 | 0.024 | 0.118 | 1.135 |

(a) Underground labor costs include surface labor employed in steel shop and other surface labor allocated to the several underground operations.
(b) Includes power for air compression and materials for drill repairs, air, and water lines. Labor repairing drills, operating compressors, and laying air and water lines is included under "Labor."
(c) Development cost is higher than normal, since more development work was done during the year than was required to keep pace with the ore extraction.

# Outline of

# *Future Mining and Metallurgical Operations at Flin Flon Mine,*

## in Northern Manitoba

IN THE first annual report of Hudson Bay Mining & Smelting, which is operating the Flin Flon mine, in northern Manitoba, R. H. Channing, Jr., who is in charge of operations, outlines the method of handling the ore, as follows:

The ore will be mined simultaneously by open-pit and underground methods. The area for open-pit operations is located in the central portion of the ore-body, where it has at the surface a maximum width of 300 ft. From this pit a total of between 5,000,000 and 6,000,000 tons of ore will be mined by electric power shovels.

All the ore will be crushed and treated in a flotation mill, which will deliver three products: copper concentrate, zinc concentrate, and a tailing product for cyanidation. The copper concentrate will be smelted in a reverberatory furnace, the matte converted, and the blister copper, containing the greater part of the gold and silver content, shipped for refining. The zinc concentrate will be roasted and leached. Refined zinc will be recovered by electrolysis and cast in marketable form for shipment. The tailing product will be treated in a cyanide plant at the property for the recovery of gold and silver content.

A pilot mill has been in operation throughout the year. This was necessary to determine basic design data for the main flotation mill and to improve metallurgical results. The ore required for this mill was mined and the necessary development work in the mine carried on. This consisted of a drift south from No. 2 shaft, with crosscuts east and west. From these crosscuts additional parallel south drifts were driven, and one of these was extended to connect with the new No. 3 shaft at the southern extremity of the developed ore. This shaft was sunk during the year and will be used as a safety exit, for ventilation purposes, and later to develop this portion of the mine. An operating crosscut was also driven on the main level to a point underneath where the main hoisting shaft for the mine will be located, and a raise, which later will be enlarged to full shaft size, has been here carried up toward the surface.

A large amount of engineering data necessary for the

*Aërial view of the Flin Flon mine surface plant, in northern Manitoba*

design of mine and metallurgical plant has been secured. Examination of outside properties, including sampling and reports, was made of 39 groups of claims during the year under review. Two small groups of claims were purchased.

A temporary power plant located on the site chosen for the copper-smelting plant, and which will later become part of the permanent plant, has been designed, equipment for it has been purchased, and plant units are under construction. This plant will deliver 1,200 hp. It will be used with the present mine power plant for construction purposes and preliminary underground development. The site for the metallurgical plants has been determined. It is close to the mine, eliminating ore transportation, and is on a sloping hillside, so that advantage can be taken of gravity in the movement of ore and other materials, and good drainage is possible.

All plant railroad tracks have been located and are near completion. Buildings are being erected to house and take care of the workmen during construction.

The general designs, both for the mine and metallurgical plants, have been determined. These are all laid out to permit doubling capacity. Relative locations of one department to another have been settled, and the work is being carried out on the final detailed drawings. A contract has been made with the Dominion Bridge Company of Canada for all the structural steel required, including its fabrication and erection. A steel warehouse building has been erected and is in use. Woodworking, machine, boiler, and blacksmith shops, all of steel, are now being fabricated, and will be erected soon. Specifications have been issued for the necessary mining and metallurgical equipment, and final decisions will be made as to this and orders placed as soon as all competitive bids are available. In addition, a large amount of work has been done on general power and lighting distribution, water supply, heating, and sewage disposal.

In the company's Flin Flon mine, by underground workings and by drill holes to a depth of 900 ft., below which exploration has not been carried, a continuous orebody is developed to a length of about half a mile and having an average width of 70 ft. This is estimated to contain to the depth mentioned, at which point, while narrower, no decrease in grade is apparent, 18,000,000 tons of ore averaging, with dilution, copper 1.71 per cent, zinc 3.45 per cent, gold .074 oz., and silver 1.06 oz. This will be mined and treated at the rate of 3,000 tons per day, and is estimated to yield an operating profit, before depletion and depreciation, of $3.50 per ton based on the following metal prices: Copper, 15c. per pound; zinc, 6c. per pound; and silver, 50c. per ounce.

The annual production will be about 30,000,000 lb. of copper and 50,000,000 lb. of zinc, with corresponding gold and silver products.

# Selective Flotation Benefits Lead Industry

NO important new lead districts have been discovered in recent years, but the world's resources have been largely expanded as a result of more efficient metallurgical processes, says the U. S. Bureau of Mines in a recently issued report. As is well known, lead and zinc are typically associated in nature. Ores of both metals are mined together in many parts of the world, but previous to the introduction of the Wilfley table, in the 'nineties, the separation of the lead and zinc was incomplete and wasteful. In the Mississippi Valley, lead and zinc have been separated with fair success by means of jigs, but in the Western United States the lead and zinc, and not infrequently also copper and iron sulphides, are so intimately mixed that relatively fine grinding is necessary to liberate the individual minerals. Development of methods of treating the complex ores of the Rocky Mountain states is one of the most interesting chapters in the history of ore dressing. The shaking table made possible economic operation of an enormous number of deposits, but did not succeed in effecting a thoroughly satisfactory separation. Zinc blende in particular, being intermediate in specific gravity between the lead and the gangue minerals, was not recovered satisfactorily.

Even before the World War, flotation was being employed to improve the recovery of sulphide minerals, particularly as an accessory process for the treatment of slimes, but it was not until after 1918 that methods were devised whereby the various sulphides present in complex ores of lead and zinc could be separated commercially by flotation. In North America, the Sullivan mine, in British Columbia, was the first to introduce selective flotation of lead and zinc on a large scale, and it was not until 1924 that the effects of this new method became apparent in the production statistics of the United States. The fact that a reasonably clean separation can be effected by this relatively simple process has made possible the profitable operation of many mines that otherwise would at times have been forced to close down as a result of low price levels.

In the Mississippi Valley and Eastern states, where the ores are less complex, the effect of this new method has not been revolutionary. In consequence, operators in these states have fallen behind their Western competitors. The reasons for this are somewhat complicated. By using selective flotation the mills in the Western states are making cleaner products and recovering more zinc. Instead of being penalized, as formerly, the zinc thus saved is now being paid for and contributes to the operating income of the mining companies. Moreover, much of this new Western zinc, being refined electrolytically, is produced so cheaply that under existing conditions it introduces serious competition as against the product of retort smelting in Central and Eastern states. This situation relates primarily to zinc, but nevertheless reacts upon the lead situation. To be sure, the Western states have increased lead production, but did so essentially because they have been able vastly to increase their zinc output. In the Mississippi Valley, on the other hand, the considerable proportion of the lead production coming from small mines that are dominantly zinc producers has been curtailed.

Recently, the American Bureau of Metal Statistics canvassed the principal Western producers to determine the amount of lead and zinc ores beneficiated by flotation. The result shows a rapid increase in lead output by selective flotation and other flotation methods. Production of lead in flotation concentrates in the Western states accounted for by the canvass indicates that at least 56 per cent of the lead from Western ores was recovered by flotation.

# The Use of Letters in Promoting Mine Safety

By D. Harrington and C. W. Owings
*Chief Engineer and Associate Engineer, Safety Division, U. S. Bureau of Mines, Washington*

MANUFACTURERS have long realized the value of keeping the interest of employees focused on the products manufactured, for in so doing efficiency in the organization is maintained or even increased. One method of attaining this goal is through a publication termed a "house organ." In recent years this idea has been adopted, to a comparatively limited extent, by mine operators in an effort to obtain greater safety and operating efficiency from the bosses and the men. There are several adaptations of the "house organ" idea to mining; some companies publish a mimeographed, multigraphed, or printed pamphlet devoted in whole or in part to safety at regular intervals. Generally circulation is limited to only a portion of the employees and to a few persons outside of the company organization. Another plan is that of sending letters (mimeographed or multigraphed); it seems probable that this method carries with it the greatest amount of the "personal touch" so essential in effective educational work. This paper will treat of the letter method of spreading safety propaganda.

One type of letter is that sent by the safety official or possibly some operating official to all foremen or bosses; another is a letter issued every week or every month, or at irregular time intervals, to all employees—not only to the mine officials but to every worker in every occupation above or below ground around the mine. The letters are prepared by the safety director or engineer, or by some higher official such as the general superintendent or the general manager. If it is contributed by the general manager, the value of the letter is greatly enhanced, as it shows an active interest on his part in the men as well as in the mine and indicates that he is reasonably familiar with mining conditions. In fact, it practically forces him to keep in intimate touch, not only with the mine operations, but also with the mine itself and with the miners as individuals, or at least as human beings. The greatest value, however, is the impression given to the employees that the management is definitely behind the safety movement.

Letters to the bosses should have a distinct place in the safety program. The message delivered can be direct and at the same time convey no criticism of the bosses to the men under them, as would be the case in the letters directed to all employees. There is a psychological effect on the bosses who see their names in the letter as having a good or bad record, especially if a bonus or a bonus penalty system is in effect. Those having few accidents among their men strive to reduce the number still further, and those whose men are frequently injured strive to attain the best record possible. Moreover, the mine boss is entitled to have placed before him in "black and white" from time to time the definite ideas and attitude of the "higher-ups" of the organization so as to have a definite basis upon which to formulate his own ideas and policies toward his work.

The bosses in any mine are only a small part of the underground personnel; therefore, to keep in contact with the men, a letter should be sent to all employees once a week, once a month, or possibly at irregular intervals when there is a definite message to be transmitted to them. Such letters should not be long, should not cover too many subjects, and should be written in simple readily understandable language. It is of decided advantage to discuss only one subject or accident in any one letter.

Below is a copy of a letter delivered to workers of United States Coal & Coke, Gary, W. Va., an organization with a fine safety record, at their working places:

To all employees:

Thomas Mechaugar, coal loader, 53 years old, Slavish, married, with four children, was seriously injured at No. 2 Works on Wednesday, Nov. 9, at 8 a.m., by fall of coal . . . This accident is unfortunate for the man and for No. 2 mine, inasmuch as this is the first TIME-LOST injury that has occurred in that mine during 1927.

The safety committee, after hearing the evidence, decided that the injury was caused by the fact that the injured man was in too big a hurry to load his car and did not pay attention to the dangerous condition which existed in the place he was working. . .

Investigation of the accident further brought out the fact that the assistant mine foreman had not examined the rib from which the coal fell, although he knew it was loose and he had not specifically instructed the man as to the danger in his working place. He had exercised extreme care in the past, he had a 32 months' record when this accident occurred. This record was considered when he was only reprimanded instead of being discharged or suspended.

Very truly yours,
General Superintendent

This letter, as will be observed, deals wholly with one accident. It describes the manner in which the injury was received, the cause of the accident, discusses the surrounding circumstances and conditions, and places the responsibility. There is one important point to note carefully; company responsibility through its officials is not dodged, and the assistant mine foreman, although adjudged to blame, was only reprimanded because of his excellent past safety record. In other words, it indicates that safety records will be commended and rewarded, but that no mercy will be shown the careless workers, including mine officials.

About 1,200 multigraphed letters, each giving a different message, have been sent from the general superintendent to each of the U. S. Coal & Coke employees at Gary, W. Va. Although every letter carries the safety captions heretofore mentioned, some of them are concerned largely with efficiency, or convey some thoughts on patriotism, good citizenship, or give information as to mine gases or dusts. The letters deal chiefly with critical analyses or statements concerning accidents, yet many are congratulatory when calling attention to the good safety or efficiency record of a mine, of an official, or of an individual employee. This type of contact work by the mine management in taking all of the individual employees into its confidence unquestionably has a good effect not only as to safety but also as to efficiency and kindliness of feeling between employer and employee. The opportunity to send to the workers commendation for notable achievements in safety and condemnation of unsafe practices should be grasped by every mine operator. Rewards in the form of more satisfied workers, decreased accidents, and, as a consequence, in economy of operation, will far exceed the cost and effort expended in this most excellent type of educational work.

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# COST-CUTTING INNOVATIONS

## How to Protect Iron Piping From Corrosive Mine Water

*Expense of Replacement and Delay May Be Reduced by Painting . . . Tar-Paper Protective Wrapper Is Effective . . . Discarded Air Hose Provides Covering for Small Pipes*

By Don Daboll
*Ray, Ariz.*

PIPE in metal mines is usually subject to corrosion. If corrosion is rapid, the damage done to unprotected pipe may be a constant source of trouble, and may, in extreme cases, be the cause of expensive output delays. In some copper mines where copper sulphate and sulphuric acid abound, the effect of corrosion is particularly annoying. Iron

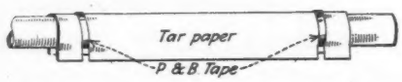



*Fig. 1—Method of covering pipe with tar paper*

pipe exposed to a drip of strong copper sulphate solution or sulphuric acid may be eaten through within a few weeks. In mines where corrosives are active, measures should be taken to protect the pipe against them. This may be done to advantage by painting the pipe with an acid-proof paint, by covering the pipe with a protecting wrapper, or by hanging the pipe free of moistened timbers and earth.

Almost any "tar paint" is effective when used as a corrosion resistor. Pipe properly treated with such a paint withstands corrosion much longer than pipe which has not been so treated—so much longer, in fact, that the value and utility of painting are unquestionable. Painting pipe underground, however, involves some disadvantages, such as lack of sufficient light, inaccessibility of certain parts of the pipe, and the presence of a film of corrosive moisture on the pipe. The first two disadvantages are obvious ones; but the last one is a greater disadvantage than is at first apparent. Moisture collects quickly underground; a dry surface is, therefore, hard to obtain; corrosive-resisting paint has no affinity for corrosives. Consequently, the paint brushed over the corrosive will not adhere. The final result is an ineffective, blistered coating. On account of these and other difficulties, it is, as a rule, better to paint pipe before taking it underground.

Above ground, the paint may be applied in one of the three ways usually employed in applying paint; that is, by spraying, by dipping, or by brushing. Spraying is a good method. This method possesses the advantages of speed in the application of the coating, and effectiveness in resistance to corrosion. Although the coating obtained by dipping is continuous and uniform, this method should be considered carefully before being undertaken, because considerable equipment is required, and difficulties may be met in dipping long, unwieldy lengths of pipe. Careful brushing is effective. Where considerable pipe is to be coated, brushing seems slow and tedious. This method, nevertheless, is the most readily adopted, and it may sometimes be the least expensive. Pipe painted before installation will of course be more or less scratched when it is put in place. All bare places caused by tools and handling should be painted after the pipe is installed.

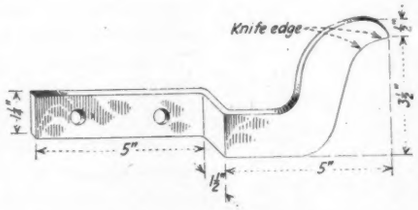



*Fig. 2—Hose splitter made from a file*

Frequently pipe must be painted after it has been installed. Owing to the conditions met in wet mines, the best method to use in coating pipe already installed is that of brushing. If the pipe runs too close to timber, rock, or other surfaces to allow proper painting, it should be loosened and drawn far enough away from such obstacles as to permit easy access to all parts. The pipe should then be made as dry as possible. If it cannot be wiped dry enough to paint, it should be heated dry with a blow torch and painted while warm. If it is under a drip, boards or tar paper should be fastened overhead to protect it during painting, and it should be permanently protected by a wrapper or covering. The ability of painted pipe to withstand corrosion depends to a large extent upon the care with which the paint has been applied. In coating pipe it is important, therefore, to make sure that the surface is entirely covered. It is almost as bad to leave small, unprotected areas, such as might occur at fittings and close to timbers where there has been careless painting underground, as it is to furnish no protection at all.

In addition to protection by painting, it is better, where pipe runs through a particularly corrosive section, to add a protective wrapper or covering of some kind. For this purpose tar paper is effective. Moreover, it is inexpensive, easily put in place, and may be made secure with P. & B. tape, or with cord which has been boiled in tar. Where protecting horizontal pipe against a drip, it is advisable to fasten the paper on the pipe in such a way as to leave a lengthwise opening on the under side of the pipe. The edges of the paper should hang free, so that the pipe will not sweat and so that adhering drip water eats on the edges of the paper hanging down, rather than on those portions of the paper which are in contact with the pipe; this arrangement is shown in Fig 1.

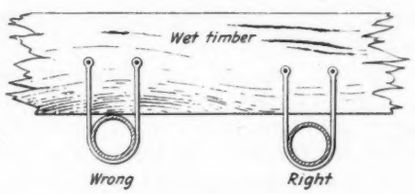



*Fig. 3—Right and wrong way to suspend piping from wet timber*

For small pipe, discarded air hose makes a very durable covering. The air hose is split lengthwise and slipped over the pipe. Breaks and joints may be wrapped with P. & B. tape. Splitting air hose with a knife is a very tedious operation. To facilitate this work greatly, a hose splitter, as shown in Fig. 2, may be made from an old file. After securing this hose splitter in a vise or to a post, the hose is split by drawing it over the blade.

Pipe corrodes rapidly where it is in constant contact with objects moistened

by corrosive solutions. Objects which are not wet enough to drip, transfer considerable moisture to the pipe. Corrosion in such places is particularly annoying in that the results of it are hidden. Thus, often bad spots are passed by unnoticed when the pipe is inspected. Moreover, if there is to be painting of such pipe, the portions pressed against timber and earth are likely to get the least paint, even though they need the most. It is evident, therefore, that considerable corrosion can be avoided by hanging pipe free of timber, rock, and other surfaces. Where pipe is fastened to timber, space should be left between it and the timber, as shown in Fig. 3. In most plants installation of pipe in contact with wet ground can be avoided by similar simple precautions.

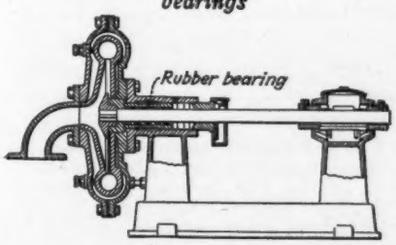
## Rubber Bearings Reduce Upkeep Expense

IT HAS been my experience that one of the most troublesome parts to keep in good condition about a plant is the main bearing of an overhung centrifugal pump, writes D. A. Hampson in *Power*. This bearing, being next to the rotor, is a hard one to keep lubricated, and unless it is properly lubricated both the shaft and the bearing tend to wear rapidly, causing the pump to become noisy and the packing to last only a short time. The stress of a fast-running impeller thrown out of balance by a worn bearing is frequently great enough to snap off the shaft at the shoulder. These troubles are more likely to occur in the smaller units than in the big ones, but the pumps are all vital to a plant's operation, whether located in the power plant or scattered as service pumps in other buildings.

Unless these pumps are made with a step-down shaft, which is the exception, any cutting from lubrication failure necessitates a new shaft as well as a new bearing.

To keep replacement costs within reasonable limits we have followed the practice of cutting off new shafts longer by the length through the impeller hub, wherever possible. With a babbitted outboard bearing, this end rarely was affected seriously, and the shaft could be turned end for end. This was always possible on belt-driven pumps and sometimes on motor-driven units. This practice saved the price of a shaft and some machine work. Also, the impeller hubs were deeply rounded, so that a sharp corner was avoided on the shaft.

*Centrifugal pump fitted with rubber bearings*




A development that promises considerable relief from this bearing trouble is found in the use of rubber as a bearing material. It is especially applicable where pumps handle water having grit in it. Rubber bearings are now stocked by supply houses in standard shaft sizes. They are made with a metal sleeve interchangeable with other sleeve bearings. The interior of these bearings is spiraled with lubricating grooves so that the rubber makes only about 50 per cent contact with the shaft. Water circulation through these grooves is the one means of lubrication.

When wet, rubber has a low coefficient of friction, which makes it an ideal bearing material from that point of view. The secret of success in its use consists of never operating without water, even at starting. A rough or pitted shaft also spells short life for the rubber, although the fact that rubber does not cut the shaft reduces this possibility to the use of right materials and workmanship in the first place.

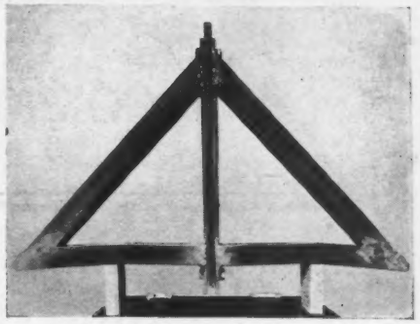
In contrast to the two weaknesses mentioned, it should be known that a rubber bearing will carry a much higher load than would be suspected, owing to its comparative non-compressibility. And the speeds at which centrifugal pumps operate present no problem at all, since rubber's anti-friction qualities show up best at high surface speeds. These qualities indicate that rubber may well be considered for plant centrifugals, deep-well pumps, flood service, and so forth.

## Welded Pipe Bracket Is Economical and Efficient

A PIPE BRACKET of welded steel possesses many advantages. It will never fail under stresses caused by vibration, expansion, or contraction of the pipe. It is lighter and, consequently, easier to install. It can be made in less time, and at less cost than a cast-iron bracket, and no production losses are involved.

The improved brackets are being made, in the form of a 45-deg. triangle to be used bolted to a wall or post, from a piece of flat steel plate and two steel angles. A 135-deg. notch is removed with the cutting blowpipe the full width of the wider leg at each angle. Next, the angles are heated at the location of these cuts, bent to 45 deg., and the joined edges of the notch are welded. Now the lower ends are mitered so that they will fit flush against the wall plate. The angles are welded to the wall plate with 1 in. clearance between, and connected at the bend by a little stiffening plate welded to them. When the brackets are in use, an adjustable pipe stand rests on the horizontal member and is held in place by projecting lugs extending downward between the angles.

Brackets of this construction, made of a plate 30x½x4-in., and two angles 2½x1½x¼ in., were subjected to the following test: They were bolted together back to back, so that they could be placed conveniently in a compression machine. The average load per bracket for two tests to produce permanent deformation was 14,750 lb. Although severe distortion took place, the welds held perfectly, as shown in the accompanying illustration. The result of the tests convinced this manufacturer that welding would give him an improved product and a dependability which the other type of bracket lacked.



*Welded pipe bracket withstands severe compression test*

## Accurate Belt Records Insure Economies

WITH the increasing use of motor drives we are likely to think of belts as belonging to the past. But, as with so many other things, we are wrong if we do, for belts still play a very important part in the driving of machinery, even in very modern plants. Furthermore, some users are learning to take a lot better care of belts than ever before. And largely because they are keeping track of belt costs and belt repairs.

Just as a sort of eye-opener, let me quote a man well versed in costs in automobile plants. His figures show that in 1924 it took a round dollar, in belt cost alone, for each motor turned out. In 1928 this cost is given as 23c. per motor, which is a remarkable saving. The figures, of course, include the belting used on all machines used in producing motors. They make a rather startling picture of the part that belts still play in modern shops and also indicate that detailed costs are being kept much more accurately than ever before.

Another motor shop reports that the cost of new belts has been reduced 50 per cent, and that repairs to belts cost 75 per cent less than they did a few years ago. This statement might be construed to mean that they were paying less for belts than formerly. In reality it means that first cost is not so important, since, by selecting the best belts for the work, and taking care of them, the need for replacements has been greatly reduced. And this also shows more accurate records than formerly.—J. R. Godfrey, in *American Machinist*.

# COMMENT AND CRITICISM

## Combined Leaching-Flotation Treatment of Mixed Copper Ores

*To the Editor of "E.&M.J.":*

I read with great interest in your issue of April 20 Dr. Rudolf Gahl's article on the development of copper ore leaching in Arizona. While reading the article it occurred to me that the processes which combine leaching with flotation have not had the share in this development which they deserve on account of their simplicity.

It would be interesting to know the actual cost of leaching against flotation, and the over-all extraction on a 1.5 ore.

Since the use of the alkaline circuit in flotation, the recovery as well as the grade of the concentrates has risen to such an extent that it is unquestionably cheaper to produce copper by flotation and smelting, than to treat the same grade of copper oxide ore by leaching and electrolytic precipitation, particularly in view of the principal item—plant amortization.

Dr. Gahl says in one of his concluding paragraphs that, reviewing the hydrometallurgy of copper, he found two opposing camps, one in favor of electrolytic precipitation, the other of sponge-iron precipitation. Dr. Gahl is right in thinking that sponge-iron precipitation seems to have been neglected, as compared with electrolytic precipitation, so far as the present development of leaching is concerned. Using sponge iron as a precipitant out of acid solution is costly, because much more than the theoretical amount is generally consumed.

It is unfortunate indeed that the results of the experimental work of Chino have never been published, as it would have been very instructive to know all the facts on sponge-iron precipitation; but it is evident that the Chino results were negative.

In my opinion it is very much to be regretted that metallurgical research work has not been more in the direction of trying to combine leaching and flotation, which I did last year by laboratory experiments. The ore I had to deal with was nearly an even mixture of oxide and sulphide. The oxide part was principally chrysocolla; the sulphide, chalcopyrite and pyrite.

Sulphatizing roasting and leaching with electrolytic precipitation suggested itself; but, on account of high cost of plant and power, no profits could have been made.

After a careful consideration of all local conditions, it was found that we could make fairly cheap sponge iron from a high-grade hematite near the plant. Experimentally, good sponge iron was made; and gradually, by experiment, a process was developed, which was a combination of leaching with subsequent flotation.

My target from the beginning had been fine grinding, and it was found that sponge iron in a ferrous sulphate solution reduced silicate of copper very rapidly.

The laboratory experiments were satisfactory, but for special reasons the company was not inclined at the time to furnish funds to test out the results in a small pilot plant.

It may be interesting to give in the following a short outline of the method I used in the leach-flotation process.

The basic reaction taking place during fine grinding may be expressed:

$$3\ CuO,\ SiO_2 + 2Fe + FeSO_4 = 3Cu + FeSO_4 + Fe_2O_3 + 3SiO_2$$

Reaction is very rapid and in a warm solution almost instantaneous. The green color of the oxide can be seen fading out to white while shaking the bottle.

The following flow sheet had been planned for the pilot plant:

Ball mill, to 50 mesh
↓
Dorr thickener
↓
Silica-lined tube mill
$FeSO_4$ solution and sponge iron added with thickened pulp
↓
Three Dorr thickeners, counter current
↓
Washed pulp from last tank to flotation mill

As seen from the formula, the $FeSO_4$ solution regenerates and the overflow from Dorr thickener No. 1 goes back to the tube mill as the solvent solution. Running counter current, the loss of $FeSO_4$ solution is very small and can be made up by acidulation with $H_2SO_4$.

Copper, of course, comes down in metallic form and is floated together with the sulphide, producing a high-grade concentrate. The fine grinding in the tube mill effects a perfect reaction. The sponge iron, about 60 mesh to start with, is completely disintegrated. While I was experimenting with sponge iron, Bulletin No. 270 of the U. S. Bureau of Mines arrived and gave me complete information regarding the manufacture of sponge iron and cost per pound.

I found the consumption of sponge iron approximated the theoretical amount, or $\frac{8}{7}$ of the copper. All the iron and steel from the attrition of crushing enters into the reaction for precipitation.

A 1 per cent ore as oxide requires 12 lb. of sponge iron. Figuring a cost for Arizona of 1½c. per pound, the total sponge iron cost would be 18c., or 0.9c. per pound of copper.

It is doubtful if the electrolytic reduction from solution can be done under 2c. per pound, so the outlook for sponge iron in leach-flotation is very promising, provided it can be worked out into a practical and successful process. The outstanding advantage in favor of leach-flotation lies in the fact that, excepting the tube mill and sponge-iron furnace, the plant would be useful in direct flotation.

I should like to see further tests made to ascertain if a successful process cannot be developed by combining reaction leaching and flotation. The source of the sponge iron would be mainly from clean iron pyrite concentrates, which in some mills even go to waste.

C. A. Heberlein

*Aroa, Venezuela.*

## Colorado and the Tariff on Metals

*To the Editor of "E.&M.J.":*

Inclosed you will find a copy of the brief, covering the tariff on metals, which has been prepared by the tariff committee appointed by the last state legislature. G. E. Collins, the mining representative on this committee, is also the chairman of the tariff committee of the Colorado Mining Association.

Mr. Collins recently left for Washington, where he will appear before the Senate finance committee. The Colorado Mining Association has been conducting a relentless effort to obtain an increase in tariff on the metals, especially lead, zinc, and tungsten.

C. Lorimer Colburn,
*Secretary, Colorado Mining Association.*
*Denver, Colo.*

The brief follows, in part:

"The condition of the mining industry in Colorado is serious and almost desperate. From 1900 to 1928 the total production of gold, silver, lead, zinc and copper (metals which are in great measure produced by

the same mines and which are therefore included in the same government statistical publications) fell from $50,000,000 to $16,000,000 annually. The amount of suffering and loss which this has involved to the people in the mining towns, and to the neighboring ranchers whose best market they afforded, can hardly be overstated. In many districts, and especially in the southwestern portion of the state, distances are so great, and freight rates so high, that the farmers and stockmen have practically no other remunerative market. Nothing is more vitally important to the farmer in Colorado than the resuscitation and prosperity of the metal-mining industry.

"Excepting the Cripple Creek district (which produces practically nothing but gold) and those districts which produce tungsten, molybdenum, or vanadium, the mines of Colorado produce silver, gold, lead, and zinc or copper, in varying amounts. They cannot be considered exclusively as precious-metal or base-metal mines. All of them depend essentially on the price of lead, even in those cases where they happen to produce a negligible quantity of that metal. For nearly all silver ores and most gold ores in Colorado contain some lead. Even if they do not, the ores or their products require eventually to be smelted in lead-smelting furnaces. The cost of recovery of precious metals depends largely on the quantity of lead ores available at the smelter, and consequently on the price of lead. An improved price for lead is therefore one method of assisting the larger part of the metal-mining industry.

"Colorado was at one time the largest producer of lead in this nation. During the 'eighties its production of this metal averaged 44.6 per cent of the total output of the United States. By 1927 the state's contribution had fallen to one-eighteenth of the total. This resulted partly from the exhaustion of the readily smelted carbonate ores of the Leadville district. Nevertheless, the lead resources of Colorado are still very extensive and widespread. Orebodies are exceedingly numerous but relatively small; so that individual mines do not justify equipment with smelting plants, or even in most cases separate milling plants; and their output has to be transported to distant treatment plants, at high cost. The loss of the output of the metal mines has impoverished our railroads, and in many instances has resulted in their abandonment; it has seriously affected distant communities which otherwise would hardly have known that the mines existed. To a greater degree, perhaps, than in other states, our ore deposits have changed in depth to what are called 'complex' ores, the economic treatment of which requires the co-operation of many other industries. There are probably no other so-called 'natural resources' which have to undergo as many or as complicated processes, before entering the hands of the ultimate 'manufacturer.' There are almost certainly none the final cost of which includes as large a percentage of labor cost, direct and indirect.

"We respectfully urge an increase of 33⅓ per cent in the present tariff rates on lead ores, lead products, and metallic lead.

"It is not easy for us to combat, in advance, the arguments that may be brought forward in opposition to the moderate increase that we advocate. No such arguments have been adduced; and we doubt if any sound arguments exist. So far as we have heard any criticism, it has been the following:

"1. The foreign importations of lead, chiefly from Mexico, are very little more than our own exports. This is true; the excess is relatively small, but its effect on prices is immediate and overwhelming. Anyone who has closely followed the relation between domestic and foreign quotations, during the last few years, cannot but have been struck by the fact that frequently, as the domestic demand increased, the price has begun to rise. After a week or two, however, weakness in the London market has followed, the London price dropping to a point at which foreign exportation into the United States becomes profitable, whereupon the New York price is reduced to hold the domestic market. Domestic and foreign prices, in fact, have seesawed, each being used in turn to hammer the price down. In other words, the natural level of prices which the free play of supply and demand in America would otherwise have brought about has repeatedly been interfered with by Mexican importations.

"2. An advance in price is not necessary to enable the larger producers to earn satisfactory profits. Up to the present, the larger deposits of Missouri, Idaho, and Utah have shown themselves able to maintain profitable output at the present price of lead. But the situation of Colorado is typical of the small mines throughout the Western states; and, after all, it is the large number of small mines, rather than the few great ones, on which the public welfare mostly rests. This is a government of men, rather than one of interests; and it is on behalf of the people of the Western states that we make this appeal to Congress. These big mines may continue to produce lead indefinitely under the existing tariffs; but our information from many of their workers and technical staffs leads us to doubt whether it can be done without drawing unduly on their richer ore. Their interests are represented before Congress by the men who exercise the financial control, and who are, in the great majority of instances if not in all, themselves heavily interested in foreign mines. In any case, if the mines of Colorado, and the smaller mines throughout the West, are forced to close down permanently, and if, as must follow, the railroads which now haul their products and the smelters which treat their ores also go out of existence, the final result will be that the few big mines will obtain a monopoly, and the consumer will have to pay higher prices.

"3. Advance in prices will tend to increase output. The increase in tariff which we advocate cannot increase prices more than its amount; directly this is exceeded, Mexican lead will come in and restore the balance. The effect can only be to raise the minimum price to a figure at which our industry can barely exist, during periods of low world prices. Increase of tariff to this moderate extent will tend to stabilize prices, and thus will benefit the real consumer, who does not profit by the sudden fluctuations which have characterized the lead market during recent years. A 50c. increase in tariff on lead will merely increase output to a point where the United States production will equal consumption.

"4. Advance in price will tend to encourage substitutes. The reply to this is that a 50c. advance cannot possibly have any such effect. The violent fluctuations in price that we have experienced in recent years, ever since the war period, and which, as is well established, are to some degree discouraged by moderate protection of home production, may necessitate substitution, to the ultimate injury of industry.

"Many of the reasons for a moderate increase in the tariff on lead apply also to a similar increase in zinc tariff. On the other hand, we have the fact that the United States produces a surplus of zinc which must be exported. This being the case, it may be questioned whether a duty can be practically effective.

"There is, however, good reason to doubt whether this condition will be maintained in the future. Increased production from Canada and Mexico is threatened; and as this production will be made at low cost, it may displace the production of some of our domestic mines. We respectfully commend to the consideration of Congress whether an increase in tariff, to forestall any such future development, should not be made at this time; or, as an alternative, the Tariff Commission might be instructed by resolution of Congress to proceed in advance with such of the necessary investigations as may be possible, with a view to making prompt recommendations to the Executive under the flexible provisions of the tariff, if the threatened emergency should actually arrive, before a great part of our domestic industry shall succumb to foreign competition. The Ways and Means Committee of the House of Representatives proposes to provide that lead and zinc contained in complex ores shall be admitted free of duty unless actually recovered. Such a provision seems very plausible; nevertheless, it is ambiguous, and may form a source of serious danger unless carefully guarded. The progress of metallurgy is so rapid that metals that are not recovered today will certainly be recovered tomorrow; and if imports of such metals are permitted free of duty, they will constitute a continual menace to the domestic producer.

"The Legislature of Colorado has memorialized Congress for a duty on silver. The United States produces more silver than it consumes and it is doubtful if a tariff would bring any relief to the silver miners. The committee feels that some other way must be found to help this important industry.

"We respectfully reiterate the request heretofore made on behalf of the tungsten producers of Colorado for a 50 per cent increase in the tariff on tungsten ore and metal, the tariff to include alloys, metal scrap, and all material of every kind and description containing tungsten. Years ago, when the Congressional hearings were held, as a result of which the present tariff was enacted, it was the opinion, practically unanimous, of all those qualified to judge, that a price for tungsten based on the equivalent of $15 per unit of tungstic acid contained in the ore was necessary, in order to justify the investment of capital in the development and operation of tungsten deposits. Experience of subsequent years has merely served to prove the correctness of this opinion. The undeveloped resources of the United States in tungsten are enormous; and ample to supply its entire requirements. But it is not possible, in the long run, to produce tungsten profitably without tariff protection sufficient to keep out the coolie-produced alluvial tungsten from China, and enable the domestic producer to obtain about $15 per unit. In our opinion, nothing less than an increase of 50 per cent in the existing tariff rate will effect this.

"Respectfully submitted, on behalf of the Legislature of the State of Colorado.

"CLAUDE H. REES,
"R. T. BURDICK,
"GEORGE E. COLLINS."

*"Denver, Colo."*

# INDUSTRIAL PROGRESS

## Permanence of Solution Color Standards for *pH* Control Work

ERRONEOUS impressions as to the permanency of color of solution color standards used in *pH* control work may possibly have been formed by some, according to W. A. Taylor, vice-president of the LaMotte Chemical Products Company, of Baltimore. If the solutions are given proper protection, he says, the colors, in general, should last for four or five years without changing, and even after this lapse of time any change should be within the experimental error of the method.

A word of explanation as to color standards and *pH* control will throw light on what otherwise may be an obscure subject to some:

In testing solutions in the mill or laboratory to determine their so-called "*pH*," or hydrogen ion concentration, or, in other words, the degree of acidity or alkalinity, a colorimetric method is customarily used. To the solution received for testing a reagent is added which colors it according to its *pH* content.

The test solution is then compared with a series of standard colors, each indicative of a certain degree of hydrogen ion concentration. The value of the *pH* of the test solution is assumed to be equal to that represented by the standard most closely matched. By thus matching or approximating colors, results are obtained that are sufficiently accurate for practical operating purposes.

The color standards employed must be permanent. They must remain accurate. Those customarily used are of two types: colored solutions and colored glass.

From time to time, according to Mr. Taylor, statements to the effect that solution color standards fade have appeared in print. He cites the following from p. 836 of *Engineering and Mining Journal* of Nov. 24, 1928:

"Colored solution standards are not permanent and change gradually from the day they are made; this is particularly true of the strongly acid and strongly alkaline ranges. Solution standards must therefore be repeatedly checked and replaced. . . . Need for a colorimetric method for determining *pH* values by means of standards which will not change color is met by a new glass standard *pH* indicator. . . . Its standards are the proper color and have been checked by the potentiometer method; these colors cannot change with time or use, according to the maker."

Commenting on this, Mr. Taylor says:

"We do not question the sincerity of the statement concerning the permanence of color standards for indicators covering the highly acid and highly alkaline ranges, inasmuch as a number of years ago it was true that it was impossible to prepare color standards for thymol blue, acid, *pH* 1.2-2.8, methyl red, *pH* 4.4-6.0, etc., which would stand up for more than a few days. This was also true of indicators that were widely recommended for the highly alkaline ranges, *pH* 10.0-14.0. In the first place the indicators recommended have been found entirely unsuited for *pH* work (*Ind. & Eng. Chem.*, Analytical Edition, Jan. 15, 1929, p. 44), and, in addition, no satisfactory buffer mixtures for this range were available.

"Due to such statements in recent literature, and to statements of glass standards concerning the fading of solution standards, we feel it to be only just to correct these erroneous impressions. Our research laboratory has developed color standards for acid cresol red (*pH* 0.2-1.8), metacresol purple (*pH* 1.2-2.8), thymol blue, acid (*pH* 1.2-2.8), LaMotte yellow (*pH* 2.6-4.2), methyl red (*pH* 4.4-6.0), LaMotte purple (*pH* 9.6-11.2), LaMotte sulfo-orange (*pH* 11.0-12.6), and LaMotte violet (*pH* 12.0-13.6), which are just as stable as those for bromthymol blue, phenol red, and so on, and which have been on the market for a number of years. These, as well as those for the indicators covering the remainder of the range *pH* 0.2-13.6, are universally recognized as the standard of accuracy in colorimetric *pH* work. LaMotte yellow, LaMotte purple, LaMotte sulfo-orange, and LaMotte violet were developed in our own laboratory and are available from this source only.

"With reference to the permanence of solution color standards in general, actual use in laboratory and plant has demonstrated that they are stable for a period of at least four or five years, if they are protected from excessive exposure to light and heat. Even after this period, any change that may have taken place is within the experimental error of the method—that is, 1.0 *pH*. The uninterrupted and increasing international use of LaMotte standards over the past ten years establishes a fact contrary to the above charge that these standards have been displaced by other equipment.

"Solution standards have definite and well-recognized advantages over all other types of standards such as color charts and glass standards. In the first place, solution standards must be the basic colorimetric standards, since they are the only ones which can be checked directly by the potentiometer method. Obviously, any other standards, such as color charts and glass standards, must of necessity be imitations, since they can be made only by matching them as closely as possible against solution standards. Second, solution standards are exact duplications of the test samples to which the corresponding indicator solution has been added. Since the comparison of the test sample is made with standards of a similar medium and identical color elements, an exact and accurate reading can always be obtained. This is not usually true of other types of standards.

"By co-operation with the best-known manufacturers of colored glass, we have found that it is impossible to match the various colors given by the different indicators throughout their ranges by means of solid pieces of glass. Even when several layers of glass of different shades are used for each individual standard, the match can seldom be exact, owing to the impossibility of obtaining glass of the correct shade and different batches of exactly the same shade. If several layers are used, as is usually the case, a colorless cement which will stand up for more than a few months must be found for holding the different layers together. There is little evidence that this has been done. So far as we know there is no experimental proof that colored glass is more permanent than properly prepared solution standards. Statements to the contrary are, we believe, based solely on the assumption that colored glass does not change in shade with time. Experience would rather indicate that this is not the case.

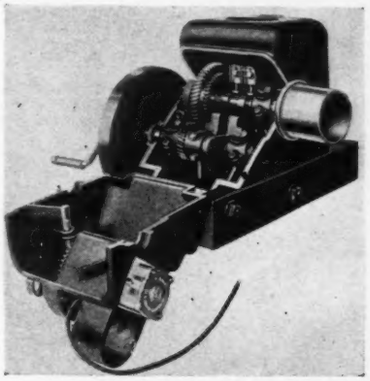
"Our own experience, as well as that of a number of other workers, has shown that it is often impossible to obtain a color match when attempting to make *pH* determinations on colored or turbid solutions with glass standards. In general, it is always very difficult and often impossible to match the color of a solution in a tube with any flat surface."

# The Equipment Review

ASIDE from the double-gap section insulator for trolley haulage circuits in mines, the equipment announced this week is of general interest and application. The new gasoline-kerosene engine described in the following is a striking development of importance. The new pulling device, for moving cars and other things, likewise has unusual novelty.

### Inclosed Engine Self-Oiling

Although the most radical departure from previous construction in some new gasoline-kerosene engines just announced by Fairbanks, Morse & Company is in the all-inclosed self-oiling feature, the engine is quite different in



*By removing two bolts the case inclosing this gasoline-kerosene engine may be opened and the parts inspected*

appearance from others of its type. In size it ranges from 1½ to 7½ hp., the 1½-hp. unit being the most interesting development in the new line. It is less than 16 in. high, 22 in. long and 19 in. wide, the weight being only 150 lb. The engine is equipped with two pulleys, one to run at 1,500 r.p.m. and the other at 750 r.p.m. It is also equipped with a mechanical regulator which permits it to be slowed down to 1,100 r.p.m. with proportionate reduction in horsepower. With these two pulley speeds and the speed regulator the requirements of almost any type can be met.

Another feature of the small 1½ hp. unit is its simplicity. It is said to have 25 per cent fewer parts than previous engines of this size. Unit construction throughout makes the cylinder, water hopper, crankcase and bearing supports for both crankshaft and camshaft integral with the cylinder and base casting. With the exception of the magneto, the engine can be assembled entirely on this casting.

Because it is fully inclosed, the engine is completely protected from dust, dirt, and rain. By removing only two bolts all working parts are made open to inspection. The self-oiling is accomplished through a special lubricating system which literally drenches all working parts in oil. No grease cups are used.

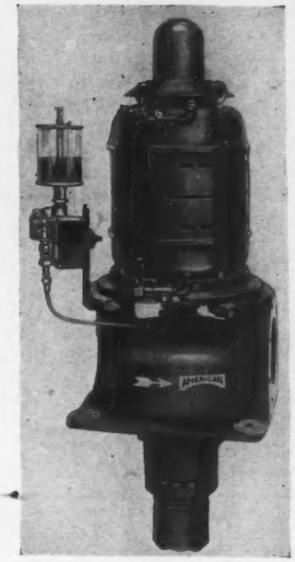
### A New Pulling Device

A pulling device that can be easily carried, handled, and operated by one man is shown in one of the accompanying illustrations. It has been developed by the T. H. Edelblute Company, of Pittsburgh, and is known as the "Anchor" Pullerjack. It consists of an arrangement of sprocket wheels, ratchets, and pawls operated by a 3-ft. handle. The tail chain is fastened to the anchorage, and attaches to the machine by a simple release lock which can be easily loosened, to release the load under full strain if desired. The load chain is hooked to the load and the loose end of the chain passes through the sprocket of the jack. By a ratcheting movement of the handle, the operator pulls on the load, and the chain passes around the sprocket, falling loosely below. The standard load chain is 15 ft. long and has a swivel. The appliance will pull continuously for the entire length of the chain in one movement.

With this device the following results were obtained at the Pittsburgh Testing Laboratory. In a straight line pull one man pulled 4,800 lb. (drawbar

*A novel pulling device in operation*

pull), and two men 6,500 lb. With a sheave block one man pulled 6,700 lb. (drawbar pull) and two men 9,800 lb. The appliance can be used on any pulling job such as moving railroad cars, pulling out mired trucks, tightening



*A deep-well turbine intended to fit small-bore wells*

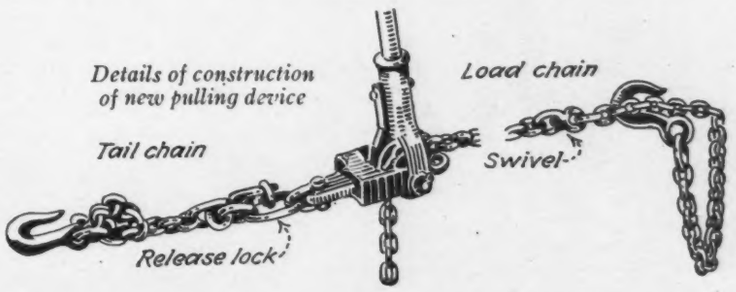
cables and wires, shifting tracks, and the like.

### New Deep Well Turbines

A turbine to fit smaller bored wells has been developed by the American Well Works, Aurora, Ill. It consists of the turbine head proper, which is the driving unit, the supporting pipe, which incloses the driving shaft, and the turbine itself, having the number of stages necessary for specific requirements. The new pump is made in 6-in. and 8-in. sizes. The turbine head consists of the vertical motor mounted on a rigid and compact base. The thrust bearing of the motor is so designed as to carry the load of the line shaft and impellers. All bearings are oil lubricated by gravity feed from the surface, the feed being electrically controlled. Provision is made for complete drainage of all waste oil and water leakage.

### Section Insulator Difficulties Overcome

Interruptions in the trolley circuits along main haulageways caused by rock falls or wrecks are of common occurrence. So that the entire haulage will not be tied up while the disturbed section is being cleared, installation of section insulators in the trolley line is customary. Thus a section of line may be cut out while the remainder of the lines are alive. These section insulators should be placed at intervals of 1,000 ft. along the main haulageways. A



section insulator should also be placed at each turnout.

Formerly the standard practice was to mount a section insulator with a dead section in the under-run in the line and mount a knife switch on the rib. This was an expensive installation and considerable trouble was caused by the dead section, particularly if it was placed on a hard haul. Standard practice is now to mount a section insulator combined with a switch in the line.

A section insulator is subjected to very severe operating conditions. A heavy mechanical strain is placed on the section insulator when there is a slate fall on the line. Very often the switch is opened under a heavy load and the jaws and blade are burned and pitted.

The Westinghouse double-gap section insulator overcomes many of the troubles experienced with some other types. The double-beam construction insures strength and rigidity. It will not become distorted, the makers claim, under ordinary strains.

The switch jaws and blade are mounted on the top and are accessible for repairs or replacements. The surfaces of the castings on which these parts rest are machined after the side bars are bolted to them, insuring the alignment of jaws and blade in case it is necessary to replace them. Jaws are held in place by means of ⅝-in. tap bolts which are easily removable. The continuous metallic under-run, which is live when the switch is closed, furnishes an uninterrupted path for the wheel. The two air gaps protect the dead side of the line when the switch is open. The lug for locking the switch in the open position is an added safety feature and complies with the compensation ratings.

One size of section insulator fits 2/0 to 4/0 round, grooved and Fig. 8 wire, and another size is adapted to 6/0 grooved, Fig. 8 or Roebling Fig. 9 wire.

## Improved Method of Installing $CO_2$ Meters

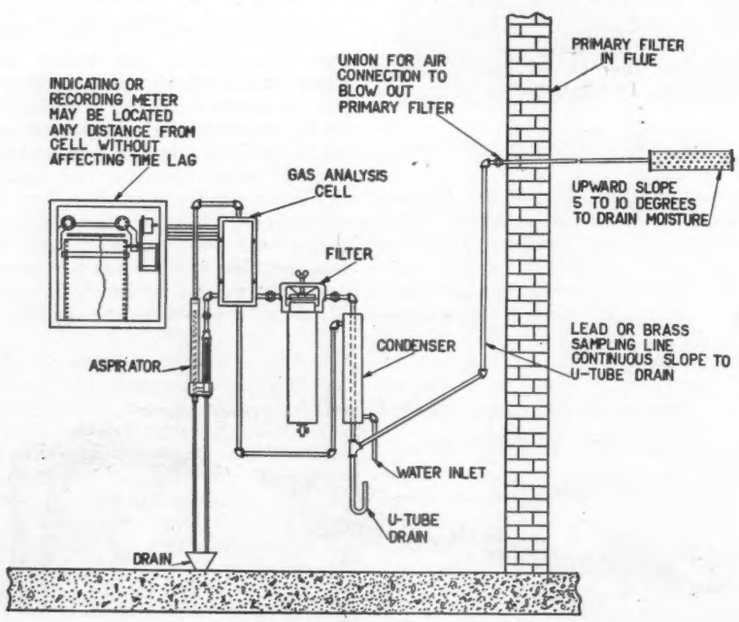
A NEW method of installing $CO_2$ apparatus, working on the thermal conductivity principle, has been devised by the Brown Instrument Company, of Philadelphia. In this system of analyzing gases, the relative capacity of air to conduct heat as compared with the gas to be analyzed is used to operate electrical indicating and recording instruments calibrated directly in per cent $CO_2$. Fig. 1 illustrates the method of installing which eliminates trouble, due to clogging, and gas leaks, which were heretofore experienced.

A primary filter consisting of perforated metal supporting asbestos cloth projects into the flue or furnace. The pipe supporting this filter slopes downwards from it so that moisture is drained off. The sampling line runs directly down to the U-tube drain which collects excess moisture and acid. The gas then passes through a condenser, where it is cooled to prevent any accumulation of moisture in the analysis cell.

A union connection is made at the sampling tube so the primary filter can be blown out occasionally. In practice, this blowing out is done only at comparatively infrequent intervals. A secondary filter consisting of a container with steel wool and cotton is placed in the line in front of the cell.

The thermal conductivity cell contains four platinum filaments of comparatively heavy wire mounted in gold-plated cells with gold-lined passages. Two of the cells contain air. The other two contain gas to be analyzed, the thermal conductivity of which is to be compared to air. From the cell, 5-wire cable runs to indicating or recording instruments calibrated directly in per cent $CO_2$.

*Sketch illustrating a new scheme of installing $CO_2$ meters*


INDICATING OR RECORDING METER MAY BE LOCATED ANY DISTANCE FROM CELL WITHOUT AFFECTING TIME LAG
UNION FOR AIR CONNECTION TO BLOW OUT PRIMARY FILTER
PRIMARY FILTER IN FLUE
GAS ANALYSIS CELL
UPWARD SLOPE 5 TO 10 DEGREES TO DRAIN MOISTURE
FILTER
CONDENSER
LEAD OR BRASS SAMPLING LINE CONTINUOUS SLOPE TO U-TUBE DRAIN
ASPIRATOR
WATER INLET
U-TUBE DRAIN
DRAIN

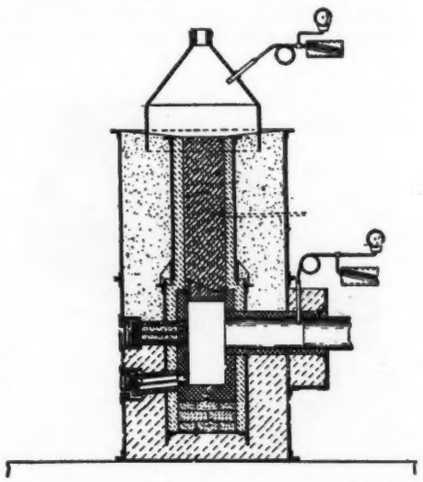
## PATENTS

TREATMENT OF MINE WATER. No. 1,714,828. May 28, 1929. J. T. Travers, assignor to The Travers-Lewis Process Corporation, Columbus, Ohio.

*Treatment of acidified mine water by passing it through travertine.*

HOLDER FOR MINERS' LAMPS. No. 1,715,148. May 28, 1929. G. B. Simmons, assignor to American Mining Tool Company, Ottumwa, Iowa.

*A design for a lamp holder to be used on miners' caps.*



CONDENSING ZINC VAPOR. No. 1,712,133. May 7, 1929. F. G. Breyer, assignor to The New Jersey Zinc Company, New York, N. Y.

*Design for a condenser.*

**Rock Drills**

No. 1,713,859. May 21, 1929. R. H. Wilhelm, assignor to Ingersoll-Rand Company, Jersey City, N. J.

*A design for a rock drill.*

No. 1,715,359. June 4, 1929. C. C. Hansen, assignor to Ingersoll-Rand Company, Jersey City, N. J.

*Design for a chuck mechanism.*

No. 1,715,842. June 4, 1929. E. F. Jones, assignor to Demag Aktiengesellschaft, Duisburg, Germany.

*Design for a hammer rock drill.*

No. 1,716,443. June 11, 1929. G. W. Hulshizer, assignor to Ingersoll-Rand Company, Jersey City, N. J.

*A chuck for rock drills.*

REDUCING ZINKIFEROUS MATERIALS. No. 1,712,132. May 7, 1929. F. G. Breyer and E. H. Bunce, assignors to The New Jersey Zinc Company, New York, N. Y.

*A porous charge of agglomerates of mixed zinkiferous material and carbonaceous reducing agent is progressively passed through a reducing chamber without substantial breaking down of the agglomerates. Sufficient heat is applied to reduce the compounds of zinc and volatilize the resulting metallic zinc without slagging or fusing the agglomerate charge. From the reducing chamber a gaseous product is withdrawn that contains metallic zinc vapor capable of being directly and economically condensed to zinc metal.*

# Personal Notes

**Guy C. Riddell** has returned to New York from Mexico and Yucatan.

**Lotan C. Read** has been retained to make an examination and report on the Madoc Hastings area in Ontario.

**L. H. Carver** has been appointed consulting engineer for Kelsey Gold Mining, owner of mining properties in El Dorado County, Calif.

**W. H. Bailey,** former chief engineer for the Illinois Steel Company, has been named chief engineer for the Colorado Fuel & Iron Company.

Dr. **F. C. Lincoln,** professor of mining in the South Dakota School of Mines, is now engaged in examining mining properties in western Nevada.

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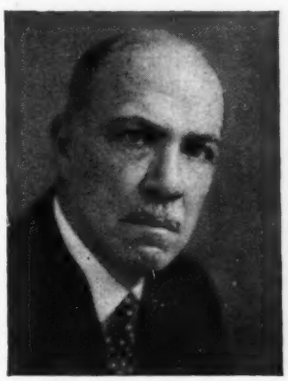
**J. W. Furness,** chief of the Minerals Division, U. S. Bureau of Foreign and Domestic Commerce, is co-author, with



J. W. FURNESS

**L. M. Jones,** of "Mineral Raw Materials," reviewed on p. 66 of this issue. Mr. Furness is a member of the committee on production control of the A.I.M.E.

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**Mrs. E. R. Coombes,** editor of the *Mining Congress Journal,* has been on a trip along the Great Lakes and through the Lake Superior iron district.

**J. Y. Murdoch,** president of the Noranda Mines, recently visited the copper-lead-zinc discoveries in the Bay of Chaleur district, in the Gaspé Peninsula, Quebec.

**J. Gordon Hardy,** mining engineer, of New York City, was recently in the Coeur d'Alene district of Idaho, studying the geology of several of the properties.

**W. Von der Porten,** and **A. E. Furst** have resigned as partners in Brandeis, Goldschmidt & Company. **Ernest Cecil Goldschmidt** has been taken into partnership in the company.

**Richard N. Hunt** returned to Salt Lake City recently from Jalisco, Mexico, after an absence of several months, and sailed on June 15 for Europe. He will return about Sept. 15.

**W. P. Belden** and **S. L. Mather** have been elected president and vice-president respectively of Canisteo-Cliffs Mining, recently formed to operate the Canisteo mine lease at Coleraine, Minn.

**E. W. Todd** has been engaged by Hilltop Gold Mines, Ltd., to make a geological survey of the company's property in the Boston Creek section of the Kirkland Lake area of northern Ontario.

**Julian Boyd,** consulting mining engineer, of Los Angeles, is making an inspection of some silver-lead-zinc properties in Durango, Mexico, for a London company, and expects to return in about three weeks.

**Lucien Eaton,** district superintendent of Cleveland-Cliffs Iron, at Ishpeming, Mich., will leave New York late in July for England and Africa. He will advise Roan Antelope and Rhodesian Selection Trust on mining problems at their properties in the N'Dola district of Northern Rhodesia.

**H. Neu,** of the firm of M. Lissauer & Company, of Germany, sailed for Germany from Quebec on July 7, on the "Empress of Scotland." Mr. Neu recently spent several weeks at the New York offices of Associated Metals & Minerals, a subsidiary of the Lissauer organization.

**Essington Lewis,** managing director of Broken Hill Proprietary, has been elected a member of the Council of the Australasian Institute of Mining and Metallurgy, to represent Australasia; and **Andrew Fairweather** superintendent of Broken Hill South, has been elected to represent New South Wales.

Dr. **Henry Mace Payne,** of the American Mining Congress, is projecting a two-year economic survey of the mineral resources of Texas. Local interests have been consulted regarding cooperation, and it is proposed to bring out in detail the location of deposits and the possibilities of mining on a commercial scale, with due consideration of markets, transportation, and outside capital.

**W. M. Archibald,** manager of mines for Consolidated Mining & Smelting, recently flew his De Haviland gypsy moth plane from Vancouver to Trail, B. C., in 3½ hours. Later he flew it to Kimberley, but in returning from Kimberley to Trail he ran into a storm and was driven south to Priest River, Idaho, where he made a forced landing. In taking off again he crashed the plane, but fortunately was not injured.

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**Edward P. Warner,** formerly Assistant Secretary of the Navy for Aëronautics, last week elected president of the Society of Automotive Engineers, and until recently professor of aëronautical engineering in the Massachusetts Institute of Technology, has been appointed editor of *Aviation.* Mr. Warner has had a long career in the aëronautical industry. His interest dates from 1910, when he constructed a prize-winning glider. He was the first appointee as Assistant Secretary of the Navy for Aëronautics. He became professor of aëronautical engineering at M.I.T. in 1924. **Earl D. Osborn,** former publisher and retiring editor of *Aviation,* now a McGraw-Hill publication, will continue as contributing editor.

E. P. WARNER

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**John V. Cox** was elected president of the recently formed American Mica Producers' Association, which met at Spruce Pine, N. C., late in June. The objects of this organization are to develop American mica resources; to encourage and promote profitable mica mining, standardize mica products, develop co-operation in methods of distribution, and to find and promote new uses for mica. **D. T. Vance** and **B. C. Burgess** were made vice-presidents.

**Thomas W. Gibson** was guest of honor at a dinner given in the Parliament Buildings, Toronto, July 6, on the occasion of his promotion from the position of Deputy Minister of Mines for Ontario to the newly created post of Chief Advisory Consultant to the department. Prominent representatives of the mining industry united with members of the cabinet in paying high tribute to the efficiency of Mr. Gibson's services during the 49 years of his connection with the department, and congratulating him on his well-merited promotion. Among the speakers were **Premier Ferguson, Charles McCrea,** Minister of Mines; Sir **William Mulock,** Dr. **Charles Camsell,** Deputy Minister of the Department of Mines, and **John E. Hammell.**

# Book Reviews

## Essentials of Civilization

MINERAL RAW MATERIALS. *By J. W. Furness, U. S. Bureau of Foreign and Domestic Commerce, and L. M. Jones, U. S. Bureau of Mines, Washington, D.C.: United States Government Printing Office. Pp. 278. Free.*

THOUGH issued under the unpretentious heading of Pamphlet No. 76, Department of Commerce Trade Promotion Series, this compact little publication is sure to win for itself an honored position, or at least a place of frequent reference, on the bookshelves of any individual or organization concerned with world trade in minerals. Primarily a statistical compilation, the authors succeed in presenting their subject matter in an easy-to-read style that should prove of material assistance in overcoming the common distaste for statistics in any form.

In large part this work consists of a statistical study of world commerce in various minerals during the five-year period 1923-27. Specific estimates of ore reserves and mineral resources available for future consumption are given occasionally throughout the book, though the authors find it necessary to confine themselves mostly to generalized statements in this direction. A short introduction is followed by four pages of charts, portraying graphically the commercial position with respect to mineral raw materials of the principal nations and mineral-consuming countries. Part I of the text constitutes a survey of mineral production by countries; Part II, a survey of production by minerals. Excellent judgment has been shown in the arrangement of the subjects covered by these two surveys, so that the seeker after information on a definite topic may arrive at his "destination" with a minimum of wasted effort. Further graphic and tabular studies of the relative positions of the various important mineral-producing and -consuming countries serve as summaries, which may be considered as arriving at the obvious conclusions indicated by the text.

A few random abstracts from the authors' preamble serve to force a realization of the vital importance and tremendous scope of their subject. The importance of mineral raw materials in the building up of civilization is plainly evident from the time that Egypt became a world power, coincident with the acquisition of the Maghara copper deposits about 4000 B. C., to the present dominant position of the United States, in the main owing to the mineral raw materials produced within its political confines and available to commerce. A quantitative indication of the importance of this relation to the advance of civilization may be found in the fact that more than 58 per cent of the freight handled by the railroads in the United States is in the form of mineral raw materials. Likewise, it is of interest to note that eight countries require, to maintain their industries, more than 80 per cent of the minerals described in this volume. Detailed consideration is given to the United States, Germany, France, United Kingdom, Japan, Belgium, Italy, and Spain. These countries were selected because in the aggregate they consume approximately 80 per cent of the world's total production of minerals, and control, either politically or commercially, an even greater part of the monetary value of the minerals at present used industrially. The limitation of the sources upon which the industrial world has largely depended during the last five years may be illustrated in part by the fact that the United States, United Kingdom, France, and Germany produce more than three-fourths of the world's output of coal; and by the fact that the United States, Mexico, Russia, Persia, and Venezuela produce about 90 per cent of the world's output of petroleum. Some nations have more than their share of the reserves of some minerals; others conspicuously lack reserves, and none has a well-balanced supply of all minerals. It follows from this that nations are interdependent in regard to mineral supplies, and that international movement and trade in minerals is an inevitable consequence. A mineral trade balance between countries exists that can be changed only in minor ways by any efforts of man. In this connection a fact that is rarely appreciated is that notwithstanding its large contributions to the world's production, the United States produces few minerals exported in quantities sufficient to affect the markets of the world appreciably. Though this study was made primarily from the standpoint of international trade, and not from that of the mining engineer or geologist, in many ways it will prove to hold as great interest for the technician as for the layman.

HOMAR L. JOHNSON.

PALEONTOLOGY. *By Edward Wilber Berry. New York: McGraw-Hill Book Company. Pp. 392. Price $3.50.*

THIS new work, dealing with the elements of the science, should be a welcome addition to the field of paleontology. It is designed as a text for the first-year student, and incorporated in it are a number of features commendable to a book of this type.

The numerous figures are of special value, as they are diagrammatic and hence show well those things for which they were designed.

The author keeps constantly before the reader the thought of gradual change working in the animal kingdom to produce the forms which have lived and evolved throughout geologic ages. That is, evolution and adaptation, over an almost unimaginable period of time, have brought about the development of the animal types. The presentation has been accomplished in a manner which makes the information readable and interesting.

The first two hundred pages, devoted to the invertebrates, treat with greater fullness those classes and phyla which are of greatest geologic importance. Worms, for example, are dispatched with but a page and a half; while the mollusca, in nearly 60 pages, are discussed as to structure, activities, development, adaptation, habitat, evolution, classification, and relations.

Vertebrates are handled in a chapter of 154 pages. In this discussion, which should be of interest to any reader of scientific literature, the author describes the nature, life and evolution of vertebrates of the past. Here are the ancient fishes, amphibians, reptiles, including the impressive dinosaurs; birds, with their great variety of size and adaptation; and mammals.

Primates are shown to be relatively closely related and in the sub-order Anthropoidea the author states that the separation of the family Hominidae (man) from the family Simiidae (apes) is "to a large extent a matter of sentiment, rather than of zoological evidence." The final pages deal with man's evolution from a common ancestral stock with that of the apes to his present status. A glossary of several hundred paleontologic terms follows the text.

DONALD M. FRASER.

LAKE SUPERIOR IRON ORES. *Directory of Mine Operators and Statistical Data. Lake Superior Iron Ore Association, Cleveland, Ohio. Pp. 18.*

THIS pamphlet, which is issued for the benefit of the members of the Lake Superior Iron Ore Association, is a useful source of information. Ten of its eighteen pages are devoted to a directory of mine operators and sales agents that is unique in its completeness and up-to-date character. For each mine of each company, the location, operating status, mining method, ore treatment process and name of superintendent are given, in addition to details regarding the general organization. These data are tabulated, facilitating reference. The remaining pages are filled with statistics (1909-1928) relating to annual shipments and receipts of ore, from ranges and at Lake Erie ports, respectively. W. L. Tinker is secretary of the Association.

# NEWS OF THE WEEK

## *Summary*

*HEARINGS on freight rates for ores, concentrates, and metals will start at Chicago on Oct. 7. Other hearings will be held in New York, St. Louis, Salt Lake City, and Butte or Helena. Page 69.*

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*Noah Timmins, president of Hollinger Consolidated, has taken an option on the Owen Lake property, near Houston, B. C. This was formerly controlled by Federal Mining & Smelting. Page 70.*

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*United Verde Copper has applied to the Federal Power Commission to use the waters of the Little Colorado River in providing power for its operations in the Jerome district of Arizona. Page 72.*

* * *

*American Smelting & Refining has just started sinking a new 2,000-ft. shaft at its San Pedro mine, San Luis Potosi, Mexico. Page 68.*

* * *

*International Smelting has acquired control of all the holdings of Knight Investment, in the Tintic district of Utah, through its subsidiary, North Lily. Development will be started immediately. Page 71.*

* * *

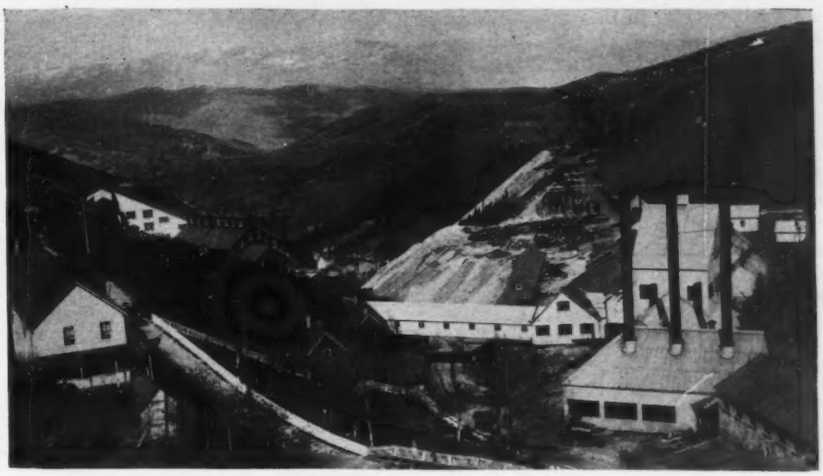
*Broken Hill Proprietary and Block 14 will reopen their mines in the Broken Hill district this month, according to advices from Australia. About 1,200 men will be employed. Page 72.*

* * *

*Tom Reed Gold has filed suit against United Eastern for $2,000,000, charging the latter with taking ore of that value from Tom Reed ground in the Oatman district of Arizona. Page 71.*

* * *

*Excavations for the foundations of the new Ontario Refining plant, at Copper Cliff, Ont., are sufficiently advanced to estimate that by next winter all the buildings will be closed in. Page 72.*



*Surface plant at the Silver King Coalition mine, Park City*

## Current Utah Mining Situation Shows Unparalleled Prosperity and Activity

By Gail Martin
*Special Salt Lake City Correspondent*

IN THE last six months, Utah's non-ferrous mining industry has enjoyed a period of practically unparalleled prosperity and activity. All past dividend records, even those of the war years, have been surpassed. Unless an unforeseen contingency arises, the total for 1929 will be about $31,000,000, as compared with the record of $29,741,015 established in 1917. During the first half of the year, Utah mines have disbursed $16,086,711. The number of mines declaring dividends, as well as the total, shows an increase. Nine companies have paid dividends this year, compared with seven for the corresponding period in 1928.

One of these companies, New Quincy, paid its first dividend this year. Yankee Mines has resumed payment, after a lapse of several years, and Utah-Apex also returns to the list. Chief Consolidated is the only mine that has not paid dividends this year, but the company did pay them last year. Utah Copper has increased its rate from $1.50 to $4 quarterly, and is, of course, responsible for the greater part of the Utah total. Tintic Standard, Park Utah, Silver King Coalition, Bingham Mines, and North Lily are the other dividend payers.

Probably at no time in the history of the Utah non-ferrous mining industry has there been so much prospecting as in the first half of 1929. The prospecting is not of the boom variety, but is exploration done by strongly financed and skillfully directed companies that are using all of the scientific knowledge of the industry in development of new ground.

Coincident with the announcement that International Smelting has taken over 12,000 acres in the Park City district, and is advancing funds for development, was the news that American Smelting & Refining had started aggressive development at Silver Reef, at Lakeside, at Ophir, and at two places in the Park City district. Following acquisition of the Bingham Mines holdings in Tintic and Bingham by U. S. Smelting, Refining & Mining, North Lily Mining, subsidiary of International Smelting, has purchased control of the Knight Investment Company's valuable holdings at Tintic, totaling over 9,000 acres.

In the field of metallurgy, Combined Metals Reduction, at Bauer, has put into operation a unit for the selective flotation of oxidized ores, and has increased mill capacity to 450 tons daily.

Tabulation of ore production in the state for the first six-month period shows that Tintic mines shipped 2,899 carloads of ore, as compared with 3,106

carloads for the similar period in 1928. North Lily's output of 509 carloads is more than double that of last year. Tintic Standard increased production to 1,091 carloads, as compared with 988 last year. Plutus shipped the same amount as before. Output of Chief Consolidated, Bingham Mines, Mammoth, and Eureka Lily was less.

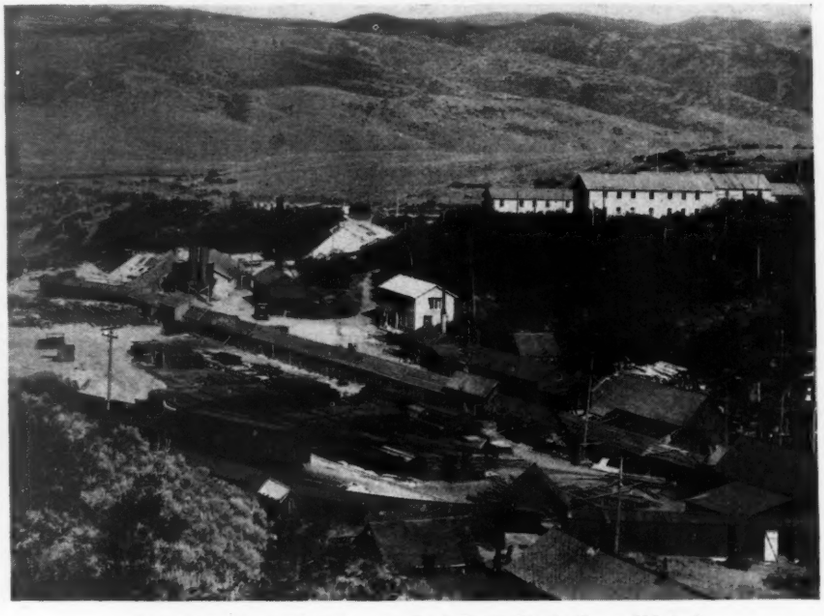
A strike in the Chief Consolidated property, north of the Beck fault, the first orebody opened up in Chief Consolidated ground in this area; discovery of the faulted Eureka Lily orebody on the 750 level of the Chief Consolidated property; cutting of 15 ft. of ore in another Chief property, the Eureka Bullion; starting production at the Eureka Standard of Tintic Standard Mining—all these events should augment the district's production.

Production at Bingham, with the exception of the increased output of Utah Copper, shows little variation compared with the first half of last year. Utah handled about 60,000 tons of ore daily, compared with 40,000 tons daily last spring.

Shipments of Park City mines for the first six months of 1929 amounted to 181,038 tons, compared with 195,600 tons for the same period of 1928. A decrease in the amount of fluxing material shipped from the Ontario mine of Park Utah is partly responsible for the reduction, as well as the greater proportion of concentrate shipped from Silver King Coalition as the result of enlarging its milling plant.

New Quincy made a notable record, increasing its output 500 per cent, from 4,988 tons for the first half of 1928 to 32,066 tons for 1929. Park Galena, still in the prospect stage, doubled its output. A new shipper, Park City Consolidated, made its appearance on the list. Output of the district was: Park Utah Consolidated, 113,821 tons; Silver King Coalition, 28,189 tons; New Quincy, 32,066 tons; Ontario, 5,462 tons; Park Galena, 1,511 tons; and Park City Consolidated, 300 tons.

Beaver County operations have been stimulated by a resumption of shipments from Horn Silver and Moscow Silver. Exploration of the limestones in Horn Silver, depth development at Moscow as well as on the upper levels in new areas, and activity at numerous prospects have greatly improved the outlook for this mining region.



*The Ontario drainage tunnel of Park Utah Consolidated*

## Canadian Industries Plans Chemical Plant at Copper Cliff

CANADIAN INDUSTRIES, LTD., has taken over the old sulphuric acid plant formerly operated by Mond Nickel at Coniston, Ont., and later absorbed by International Nickel, and is now engaged in experimental work preparatory to the establishment of the organization's proposed larger plant at Copper Cliff. Arrangements have been completed with International Nickel of Canada for a location in close proximity to the new smelter, and plans for the new plant are now being prepared. The sulphur fumes are to be used in the manufacture of sulphuric acid, which is to be the base of several other products, including niter cake, and later, it is understood, heavy chemicals.

Ground will be broken on the site of the new plant this fall, according to present plans.

## Falconbridge Nickel Cuts 20 Ft. of Ore at 1,000 Level

Crosscutting from the 1,000 level of the new Falconbridge Nickel shaft, in the Sudbury district of Ontario, has intersected 20 ft. of ore. This is considered the most significant development since the Lindsley interests took the property over from the E. J. Longyear Company last fall. Ore was indicated at this depth by a diamond-drill hole, and the assays of the ore cut by the crosscut correspond closely to the results obtained by drilling.

## Frood Ore to Be Mined by Cut-and-Fill Methods

THE cut-and-fill method of mining, with various adaptations to suit conditions as they are met in different parts of the mine, has been adopted by International Nickel as the best plan for mining its Frood ore deposit at Sudbury, Ont. Under this method the tonnage of broken ore left in the mine at any one time will be small.

Satisfied with the progress that is being made in opening up the Frood, officials are paying little or no attention to reports of great barren stretches revealed by development work in which expected ore developments did not materialize. The facts are that the greater part of the development work is in the footwall of the deposit where no ore is expected, and owing to the irregular outlines of the deposit the drifts and crosscuts are in ore one day and out of it the next. The bulk of development work is confined to opening up the mine at the 1,600, 2,000, 2,400, 2,800, and 3,100 levels.

## A. S. & R. Sinking New Shaft at San Pedro Mine

SINKING of a new operating shaft at its San Pedro mine, in the State of San Luis Potosi, Mexico, has just been started by American Smelting & Refining. The new shaft will be put down to 2,000 ft. and will have five compartments. Workings at this mine have already reached a depth of nearly 2,000 ft.

More economical and efficient extraction of silver-lead ore from the San Pedro deposit is expected to follow starting of operations at this new shaft, but an increase in production from the mine may also result. The work of sinking is being done by American Smelting & Refining itself, and no particular stress is being placed on the time element. Ore from the San Pedro mine is shipped to the company's smelter in the city of San Luis Potosi.

## Lease Commodore Mines

A five-year lease on part of the property of Commodore Mines, in the Deer Trail district of Washington, has been taken by Ernest Elliot, of Colville, Wash., and J. O. Perry, of Fruitland. The agreement requires that the lessees build a 50-ton concentrator within the first year. The ore carries silver and some lead.

# Producers and Railroads Prepare for Commerce Commission Hearings

THE Interstate Commerce Commission has assigned for Chicago, on Oct. 7, its first hearing in its investigation as to readjustment under the Hoch-Smith Act of rates on copper, brass, bronze, lead, zinc, antimony, and tin. Railroads will be asked to furnish evidence descriptive of the present rate structure and its history; competitive conditions, if any, which affect it; transportation characteristics of the traffic; comparisons of rates and unit earnings with corresponding rates and earnings of other commodities having like or more favorable transportation characteristics; and to present proposals for readjustment of the rates. General shippers' committees will be expected to submit evidence concerning industrial conditions affecting the commodities and the freight rates; information as to location of ore production, points at which smelters are located, carriers handling ore from producing points to smelters, corporate relationship, if any, of carriers to either producing or smelting companies, points between which concentrates move, and length of haul of ore and concentrates. Other relevant evidence will be received. The commission will also hear evidence as to the relationship between interstate and intrastate rates.

After the hearing at Chicago, the commission expects to hold hearings at New York, St. Louis, Salt Lake City, and Helena or Butte. The Utah chapter of the American Mining Congress requested a hearing at Salt Lake, because that city is the center of the metal-mining industry of the West. The Montana Mining Association and the Board of Railroad Commissioners of Montana asked for a hearing at Helena so that mine operators may present their case. On the other hand, Attorney Warren Nichols, of Chicago, asked that the hearing be held at Butte. The Tri-State Zinc and Lead Ore Producers' Association requested a hearing at St. Louis on zinc and lead, and the Colorado chapter of the American Mining Congress asked that a hearing be held at Denver for Colorado interests. Bunker Hill & Sullivan requested a hearing at Spokane to consider the situation regarding rates on lead ores from Idaho shipped to its smelter, but the commission has advised the company that it would probably be convenient for all to hold a single hearing in Montana for Idaho and Montana mining interests, although it still has the Spokane offer under consideration.

Joseph B. Eastman, Interstate Commerce Commissioner, is in charge of the investigation by assignment of the commission. It is understood the commission will not separate the commodities involved for hearing, but will conduct the investigation on all of them at the same time. The American Nickeloid Company, of New York, has asked the commission to establish a rate of 72c. per 100 lb. on polished photo-engravers' zinc plates from Peru, Ill., for export, which is a reduction from the present rate of $1.04. Mining companies that have made appearances and will present evidence, include U. S. Smelting, Refining & Mining, Phelps Dodge, Calumet & Arizona, and American Metal.

Superior Zinc, of Philadelphia, has advised the commission that zinc rates east of the Mississippi River are in a bad condition and should be investigated. Electric Materials, of North East, Pa., says the present rate on ingot copper from seaboard refineries to Pennsylvania is the same as to Detroit, which the company claims is a discrimination against Pennsylvania interests. The company requests the same rates as apply to Buffalo.

To date American Smelting & Refining and U. S. Zinc appear to be the only interests that do not favor a general investigation of the rates on zinc. The latter has advised the commission that there is no necessity for the investigation, as the present rates provide for free and unrestricted marketing and distribution without undue hardships upon shippers or railroads. It maintains the investigation will impose an unjustified and undue burden in time, labor, and expense, and that a general investigation will have a demoralizing effect on the zinc industry, retarding sales and disrupting markets and conditions, to the disadvantage of producers, miners, and consumers of this metal.

On the other hand, the general investigation is favored by Hegeler Zinc, of Illinois; Anaconda Copper, United Zinc Smelting, and New Jersey Zinc, which claims the zinc industry is in a depressed condition and should be allowed to present its case in a complete investigation. The American Rolling Mill Company, of Ohio, says the competitive relationship should be maintained and that the inquiry should include all points of origin and destination. Hirshler Metals, of New York, favors an investigation of rates on zinc for export, saying the raw material should have a lower rate than the finished product. Investigation of the rates from Illinois, Wisconsin, Missouri, Oklahoma, Kansas, Montana, and Idaho is favored by the Missouri Pacific Railroad.

## Consolidated M. & S. Buys Railroad Near George Copper

ANNOUNCEMENT has been made that Consolidated Mining & Smelting of Canada has purchased the Canadian Northeastern Railway from Vancouver Holdings. The consideration has not been made public.

The Canadian Northeastern was started by Sir Donald Mann, Canadian railroad contractor, as a Pacific link of a transcontinental railroad, but when it had been built 14 miles from Stewart, B. C., up the Bear River valley the war came and construction was stopped. In 1921 the line was optioned to the Algunican Development Company, a Belgian concern that reconditioned it to facilitate transportation of supplies to the Independence group, on which it had an option, but before the line was put into operation a cloudburst swept away much of the work that had been done, and this, together with the unfavorable rate of exchange on Belgian currency, caused the company to withdraw from the district. The line remained idle until two years ago, when interests in Vancouver and Great Britain bought the line from Sir Donald, erected a sawmill, and did some repair work and a considerable amount of surveying for its extension.

The present end of the steel is 6 miles from the George Gold-Copper Mines property. Recently, by the acquisition of vendor's shares, Consolidated increased its holdings in that company to 92 per cent and it is evident that the primary reason for the purchase is to secure an outlet to tidewater for the ore from that property, though no official statement has been made. Moreover, Consolidated took up last fall 54 claims near Howser Lake, and the extension of the line is to be along the shore of this lake.

Consolidated, through its new subsidiary, the Northern Prospecting Syndicate, has signed a contract with Canada Western Airways for the transportation of men, machinery, and supplies from Stewart to Howser Lake. Airways has dispatched the first plane for Stewart, and it is expected that planes will be plying between Stewart and Howser Lake steadily for the next four or five weeks.

## Porphyry Reserve to Operate Old Louis d'Or Mine

An instrument filed in the office of the recorder of Gila County, Ariz., by Porphyry Reserve Copper provides for a $500,000 mortgage on its property, formerly known as the Louis d'Or mine, adjoining that of Inspiration Copper, in the Globe-Miami district. This document is believed to indicate early financing of the company and resumption of operations. Last year the Louis d'Or property was sold at a public sale to satisfy notes held against the original company. The property consists of 147 claims, totaling 2,800 acres, developed by several shafts and tunnels. At one time the company made an official estimate of 150,000,000 tons of reserves, averaging 1.2 per cent copper.

## Stansbury Range Area Under Systematic Development

TWELVE or more mines are active in the Stansbury Mountain Range, west of Grantsville, Utah. This does not include those properties doing assessment work. Several mining engineers who have examined this area, near Great Salt Lake, agree that more development work should be done than has yet been undertaken. Mineralization was first developed about 60 years ago under the leadership of General Connor, "the Father of Utah Mining."

At the Utah Bunker Hill mine, about 28 claims in the Miners' Canyon section, 9 miles northwest of Grantsville, a three-drill compressor and a gas engine are being installed. Sullivan jackhammers will be used. The company has a tunnel driven 425 ft. into the formation to cut several strongly mineralized fissures at their intersection with the contact of a blue and a white limestone. This property was recently mapped.

Stansbury Apex Mining owning 15 claims in Miners' Canyon, is employing ten men and has a shipment on the dump. Calumet Mining is driving a tunnel. G. W. Buckley, owning two claims in Broad Canyon, has sunk two shafts in his Broad Canyon property and is driving a tunnel.

The property of Falk Mining has been equipped for development with power machinery, and a tunnel is being driven. The Third Term mine is being retimbered for a resumption of development. Benmore Consolidated Mines has been organized to develop a consolidation of Harker Canyon properties totaling 45 claims. Power equipment is to be installed. Work is also being done on the Al Hudson, Ben Clark, and other properties.

## Golden Wonder Installing New Flotation Plant

GOLDEN WONDER MINES is now installing a 150-ton flotation plant at its Tip Top property, in the Humbug district, Yavapai County, Ariz., according to F. E. Riddle, president of the company. A similar unit will be installed at the Columbia property of the same company, about 3 miles from the Tip Top.

These properties, and three other groups, were acquired about two years ago by Golden Wonder. They total 1,500 acres of ground, under lease and bond, with option to acquire. The road between the mines and the Phoenix-Prescott highway has been repaired so that a truck may travel over it at 10 to 15 miles an hour. Cheaper transportation thus made available is expected to permit mining much material that was formerly rejected as junore.

Ore at the Tip Top, which has been worked since 1880, contains silver and tungsten. A shaft has been sunk to 830 ft. and a tunnel has been driven about 1,200 ft. The shaft is now under water to the No. 2 level. At the Columbia, Golden Wonder, and Yankee Maid groups, gold is the predominating metal in the ore and a cyanide section will probably be added to the flotation plant when it is installed. Development of these groups has been at comparatively shallow depths so far.

## Ontario Legislates on Mine Rescue Stations

AS AN aftermath of the disastrous fire in the mine of Hollinger Consolidated, in the Porcupine district, Feb. 10, 1928, the Ontario government has adopted a new mining regulation. The ruling carries out one of the recommendations made by Judge T. E. Godson, of the commission that investigated the disaster. The regulation makes it compulsory for all mining companies at Timmins, Kirkland Lake, and Sudbury to equip and maintain rescue stations for use in mine disasters, these stations to be under the jurisdiction and control of the Provincial Department of Mines.

## New Zealand Quicksilver Plant Is Being Erected

Plant and buildings are under construction to treat ore from the cinnabar deposits at Ngawha Springs, north of Auckland, New Zealand. The works are being erected for Kaikohe Development, Ltd., a subsidiary of Imperial Chemical Industries, Ltd. The plant includes two rotary furnaces, for smelting, and condensers to collect the quicksilver. Local engineers say preliminary crushing of the ore is not necessary.

An internal-combustion engine will furnish the power for the enterprise. Operations are expected to start in about three months. About £75,000 will have been spent in the construction.

## Mount Shasta Silica Protects Diatomite Claims

Mount Shasta Silica, owner of diatomite claims in Shasta County, Calif., has secured a temporary injunction against alleged claim jumpers and has 30 men engaged on annual assessment work to protect its right to its claims. The company has expended more than $100,000 and erected a crushing plant to prepare its material for the market, but has not been in operation for some time.

## Double-O Retimbers Tunnel

Clearing and retimbering a bedrock tunnel is in progress at the Double-O property, in Placer County, Calif., east of Colfax. The tunnel is 1,368 ft. in length, and it is expected that several hundred feet in addition will be necessary to cut the Tertiary Channel.

## Timmins Options Owen Lake Mine, Near Houston, B. C.

NOAH A. TIMMINS, president of Hollinger Consolidated Gold, has secured an option on a controlling interest in Owen Lake Mining & Development, which holds under options a consolidation of nearly 100 mineral claims, at Owen Lake, 25 miles south of Houston, B. C., on the Canadian National Railway. The consideration is reported to be $1,100,000, and a first cash payment of $150,000 has been made.

Federal Mining & Smelting took an option on part of this property in 1923, and did considerable surface and underground exploration, but dropped the option in the following year, when it dropped its options on what were then considered as the two major operations in the district—namely, Duthie Mines and Dome Mountain Mines. The property remained idle until last summer, when F. H. Taylor, who discovered the Topley-Richfield mine, took options on the property and those adjoining and started to open them up.

The provincial government built a road, and during the winter oil and steam engines, compressors, and other machinery were taken to the property. A camp was built near the shore of Owen Lake. Mr. Taylor had about 50 men steadily employed during the winter, first in construction work and later in the driving of a long tunnel and in sinking shafts. The tunnel was planned to cut sixteen veins that had been exposed at the surface, at depths of from 400 to 600 ft. By the end of last April the tunnel was in 480 ft., and four veins, ranging from 4 to 6 ft. wide and carrying gold, silver, copper, and lead, had been cut. None of these veins had been exposed at the surface. A shaft was started on the Diamond Belle group and sunk 80 ft., at which point a drift was started in both directions; crosscuts from this drift have exposed 10 to 12 ft. of silver-lead ore, running up to more than 60 oz. of silver per ton.

With the change of control ample funds for development will be available, and a much larger force of men will be employed.

## Buckingham Mines Adopts Development Program

Intensive development will be undertaken by Buckingham Mines Corporation, newly formed to succeed Buckingham Mining and Buckingham Mina Consolidated, both operating near Battle Mountain, Nev. The Buckingham shaft will be sunk to the 1,000 level. Dr. Barnum Brown, curator of the American Museum of Natural History, who has been retained as consulting engineer of the company, recently made a geological examination of the mine. He has advised that the company should center its attentions on development, leaving orebodies now proved between the 300 and 625 levels for future operation.

## Consider Railroad for Lake George Mine

CONSTRUCTION of a railroad from Bungendore, New South Wales, Australia, to Captain's Flat, near the Lake George silver-lead mine of National Mining, is being considered by the New South Wales Parliamentary Works Committee. Since 1926, when National Mining took the property over, £144,800 has been spent in development work on this property, and construction of a 500-ton mill, which can be later increased to a capacity of 750 tons daily, is planned. A pilot plant is being built, which should start operations this summer. About 400 men will be employed when the mill is in operation, giving support to a community of about 3,000 people. Bungendore is 26 miles from the mine, and the cost of transportation by road might be prohibitive.

A reservoir is now being constructed on the Molongolo River, with a capacity of 50,000,000 gal. An electric transmission line will be built to connect with a power plant at Canberra, 33 miles from the mine. Total expenditure to bring the mine and mill into production will amount to about £500,000.

## North Butte to Increase Output Again in July

UNWATERING of the Granite Mountain workings to the 3,000 level will permit increasing North Butte's output from its Butte properties in July. June production was about 125 carloads of copper ore, which showed a considerable increase over the May output. Additional stopes are being opened on all levels above 2,800 ft. Drifting on the new orebody at 1,800 ft. has shown a length of more than 60 ft. over an average width of 5 to 6 ft. On the surface, the company has completed foundations for the compressor plant. The Speculator shaft unit, with a capacity of 5,500 cu.ft., is being moved to the Granite Mountain mine and an additional 4,000 cu.ft. unit has been bought from Ingersoll-Rand.

## Tom Reed Sues United Eastern for $2,000,000

SUIT for $2,000,000 has been filed in the Superior Court of Mohave County, Ariz., by Tom Reed Gold Mining against United Eastern Gold. The complaint recites that the defendant entered the Thomas B. Reed lode claim of the plaintiff's property at Oatman and extracted gold ore and other valuable minerals to the extent of $2,000,000, through underground workings that had no outlet on the surface of the Reed property.

Some years ago Tom Reed carried a suit through the courts in which the assertion was made that it was the owner of the ore under the Big Jim claim of United Eastern, on the theory that the Big Jim orebody was a faulted segment of the Reed's Gray Eagle orebody. The courts ruled against this theory, however, and divided the ore in dispute between the two companies.

Tom Reed company now claims that the United Eastern entered its ground and mined ore to the value set out in the complaint. United Eastern exhausted the ore at its Oatman property several years ago, shut down the mine, and has since been trying to find a mine to operate in other districts. Tom Reed mine is still operating, and is reported to have struck some high-grade ore recently on the 950 level. The 950 level workings are at the bottom of the winze, which was sunk from the 800 level after the encountering of excessive water had stopped the sinking of the new Black Hawk shaft at the 900 level.

## Investigations of the Mines Branch of the Canadian Department of Mines

JOHN MCLEISH, DIRECTOR

ACTIVITIES of the Mines Branch of the Canadian Department of Mines for 1929 will include field investigation of the mineral resources of Canada with respect to their occurrence, production, technology, and use, and extensive laboratory tests and research work on fuels, oils, ores, non-metallic minerals, clays, and road material products. The work of the ore-dressing and metallurgical division is being extended by the addition of equipment for pyrometallurgical research, which will permit of special investigations in the direct reduction of iron ores, the production of sponge iron, and for investigations on the heat treatment of steels and alloy steels.

H. S. Spence will make further investigations with respect to feldspar, with a view to the preparation of a special bulletin on this subject. L. H. Cole will continue his investigations on gypsum. M. F. Goudge is making a study of the distribution, character and technology of limestones. A. H. A. Robinson will continue the survey of the gold industry of Canada with a view to the preparation of a monograph on lode mining. V. L. Eardley-Wilmot will continue a survey of the silver mining industry.

Under the direction of W. B. Timm, chief of division, a staff of engineers and chemists are conducting investigations on ore treatment. These include: C. S. Parsons in charge of the section dealing with the milling and concentration of metalliferrous ores, with A. K. Anderson and J. S. Godard as assistants; R. K. Carnochan in charge of the section dealing with the dressing of non-metallics, with R. A. Rogers as assistant; R. J. Traill, in charge of the section dealing with electrochemistry and hydrometallurgy, with W. R. McClelland and J. D. Johnston as assistants, and T. W. Hardy, in charge of the iron and steel.

## International Smelting Takes Over Knight Holdings

CONTROL of the Knight Investment holdings, in the Tintic district of Utah, has passed to North Lily Mining, subsidiary of International Smelting. On July 3, an agreement was signed by J. O. Elton, manager of International Smelting, and J. William Knight, whereby a new corporation, to be known as North Lily Knight, will be formed to take over the Knight Investment properties, totaling over 9,000 acres in the Tintic district.

Development of the Knight properties will be directly under North Lily Mining. Properties involved include the Twentieth Century, Big Hill, Empire Mines, Dragon Consolidated, Eureka Swansea, Middle Swansea, Swansea Consolidated, Tintic Drain Tunnel, and a substantial interest in the Tintic Central, Southern Eureka, and North Godiva properties, amounting to 6,159 acres of patented mining claims, 348 acres of unpatented mining claims, surface rights to 1,739 acres, and a contract on 880 acres, a total of 9,126 acres.

Funds for development of this property will come from North Lily dividends. The new company, North Lily Knight, will receive 100,000 shares of North Lily Mining in return for its properties. Dividends from North Lily amounting to $1 per share for three years, or a total of at least $300,000 for that period, are guaranteed by the agreement.

Development work will first be undertaken in the Twentieth Century property, lying north of the Iron King. The surface of the Twentieth Century is one of the most highly altered areas in the Tintic district. The Ophir formation, which is the ore-bearing formation in the Tintic district, dips into this property.

By this transaction, International Smelting, the Utah unit of Anaconda Copper Mining, becomes one of the largest mining, milling, and smelting organizations in the West. Ten years ago, the unit was steadily losing money on the operation of its smelter and a small mill acquired on a mortgage. In addition to its holding in the Tintic district, International also controls directly or through its subsidiaries nearly 12,000 acres in the Park City district.

## Two New Producers to Enter Malayan Tin Field

Two Malayan tin mines, both subsidiaries of London Tin Syndicate, are scheduled to begin production this month. Kampong Lanjut Tin Dredging, Ltd., has 71,000,000 cu.yd. of gravel proved, and 21,100 tons of proved ore reserves. Annual output is expected to be 1,320 tons of tin oxide. Rawang Concessions, Ltd., will produce about 1,000 tons annually, with present reserves sufficient for a life of thirteen years.

## Sudbury Refinery Employing 250 Men in Construction

PLANS for the new custom copper refinery at Copper Cliff, Ont., in the Sudbury district, have been completed. Temporary construction buildings have been erected, and excavations for foundations are sufficiently advanced to allow an estimate that by the time winter arrives all the main buildings will be closed in. At present about 250 men are employed on the job, and this force will be increased to about 600 when actual construction starts this fall. C. H. Aldrich, who is directing the affairs of the Ontario Refining Company, and who will have charge of the refinery operations, states that if the present schedule is maintained the refinery should be built and operating within the allotted time. The original announcement stated that the refinery would be completed within eighteen months of the time when work was started.

Generally speaking, the new Ontario refinery will follow the design and practice of the U. S. Metals refinery at Carteret, N. J. Certain changes and improvements may be made, however, with a view to simplifying the process and increasing the efficiency of the plant. The initial capacity of the plant will be 10,000 tons, or 20,000,000 lb., of metal per month, and the plant will be so constructed as to permit this capacity to be doubled. At the outset the bulk of the blister copper for the new refinery will come from the Frood mine of International Nickel. Other shippers are likely to include Sherritt-Gordon Mines and Hudson Bay Mining & Smelting, both in Manitoba.

The refinery, which is south of and immediately adjacent to the Canadian Pacific Railway at Copper Cliff, will cover about 40 acres, of which 20 acres will be yards and the remainder occupied by buildings. There will be three main buildings—namely, an electrolytic cell house and two casting buildings, one for crude copper and the other for refined copper. The cell house will be roughly 300x400 ft. and will have 1,200 reinforced concrete cells with lead linings. The casting buildings will be 200x400 ft. and will have three furnaces, each with a capacity of 450,000 lb. of copper. To double the initial capacity of the refinery the cell house will have to be doubled in size, but the casting buildings are being built so the increase can be gained with the addition of one furnace in each building.

The buildings themselves will be brick and tile construction over steel. The contract for the steel work has been awarded to the Canadian Bridge Company. Fraser, Brace & Company is the general contractor.

The cost of the new refinery is officially stated to be about $5,000,000. It is being built by the Ontario Refining Company, capitalization $5,000,000, the stock of which is owned and controlled by International Nickel of Canada, American Metal, and Consolidated Mining & Smelting, with Ventures, Ltd., participating in the holdings allotted to Consolidated Mining & Smelting. The directorate of the Ontario Refining includes Heath Steele, president; Walter Hochschild, R. C. Stanley, John L. Agnew, J. J. Warren, and Britton Osler.

## RHODESIAN DRILLING RESULTS

BWANA M'KUBWA COPPER MINING reports striking the ore zone in No. 9 drill hole of the N'Kana mine, at a depth of 2,465 ft. The first 7 ft. of the orebody overaged 0.5 per cent copper. The next 9 ft. showed average grade of 4.26 per cent. The hole is still in ore. This is the deepest copper ore thus far cut by drill in Rhodesia. N'Kana is about 22 miles from Roan Antelope, with ore in the same series of arkoses and slates.

## Two Broken Hill Mines Expected to Reopen

REOPENING of two large silver-lead-zinc mines in the Broken Hill district of New South Wales—the Block 14 and Broken Hill Proprietary properties—was expected early this month, according to reports just received from Australia. Ore from both properties will be handled through the Central mine of the Sulphide Corporation and will be treated in that company's mill. Previously ore from these mines had been treated in the Broken Hill Proprietary mill. About 1,200 men will be employed at these two properties when the normal rate of operation is reached. According to the most recent statistics available, a total of 4,554 men were employed in the Broken Hill district at the end of May.

The Block 14 and Broken Hill Proprietary mines have been closed since September, 1927. In that year, the two properties were producing at the rate of about 3,000 tons of 65 per cent lead concentrate and 2,500 tons of 50 per cent zinc concentrate a month. T. B. Birbeck, chairman of Block 14, recently stated that his company could earn a profit with lead selling at £23 13s. 9d. on the London market.

This company is exploring the Tasman & Crown Lyell silver-lead property, near Comstock, Tasmania. A geophysical survey may be undertaken at this property, a preliminary inspection having indicated that such a test might be of considerable assistance to the management.

Tunnels have been driven on the property at the 134 and 253 levels, and present work is being confined to exploration at these depths. The southwest drive, 975 ft. from the portal of the 253 level, is being driven on an orebody struck some time ago.

Operations at the other Broken Hill mines are continuing at about the normal rate. Broken Hill South recently had some trouble with its labor, and the mine was closed for three days. However, a report on operations for the four weeks ended June 1 shows that tonnage was kept pretty close to the daily average of about 800 tons. Sulphide Corporation has been increasing its tonnage slightly, and is now handling about 450 tons daily.

## United Verde Plans New Power Development

UNITED VERDE COPPER has applied to the Federal Power Commission for a preliminary permit covering a 61,500-kw. development on the Little Colorado River in Coconino County, Ariz. A dam and reservoir will be constructed on the Tolchico site, with other dams at Grand Falls, Coconino, Lower Falls, and Black Falls. The power is to be used primarily for mining and smelting operations of United Verde, but the company will sell current for public utility use in the vicinity of its operations.

## Waterpower Development Planned in Ontonagon County

REOPENING some of the mining properties in Ontonagon County, Mich., may follow development of a waterpower project in that district. Prospects of the mines in that rather remote part of the Michigan copper country will be brightened greatly by cheap power. The cost of coal and transportation has been a large item of expense. The Michigan, White Pine, and Victoria are the mines most likely to benefit by the new development.

The Northern Acquisition Company, which is sponsoring the project and giving attention to the preliminaries, has effected the organization of the Ontonagon Public Service Corporation, which will be the operating unit. W. H. Schacht, general manager of Copper Range, is president of the operating company. James H. Sickman, manager of the Ontonagon Fibre Company, is secretary-treasurer, and Frank Speese, vice-president and general manager. Considerable land in the basin of the Ontonagon River has already been purchased and a large additional acreage is under option.

## Whitedelf Starts Mill

Operation of the new 75-ton mill, designed by W. L. Zeigler, metallurgist of Hecla Mining, for Whitedelf Mining, near Clark Fork, Idaho, was started recently, according to reports from Spokane. Whitedelf has been shipping silver-lead ore to the East Helena smelter of American Smelting & Refining for the last three years.

# MARKET AND FINANCIAL NEWS

## London Financial News

By W. A. Doman

London, June 24, 1929.—It is somewhat curious that the Frontino & Bolivia, the well-known Colombian gold-mining enterprise, should have experienced adverse conditions just at the time when its "baby," the Marmajito, is having the best time of its life. Frontino & Bolivia has gone through lean periods before, but never since 1911 (the date of the last reconstruction) has the question of raising additional capital been seriously considered. Poor results obtained so far this year are caused by the lower grade of ore, shortage of power owing to the dry season, and abnormal capital expenditure on the Doña Teresa power development. The old Silencio mine is showing improvement in the No. 18 level north and in No. 19 level south, but as the new power plant will not be in operation before the end of the year, the immediate outlook is not particularly encouraging. The company has several mines on its property, and is awaiting news from John Reed, manager of the company, as to the most promising of these to be reopened. As it has a good record, the latest circular to shareholders, indicating a possible loss on the year's operations, will probably not be the swan song. The question which is being asked is "What about the Marmajito?" which is receiving some publicity nowadays.

During May, the copper output of Union Minière du Haut-Katanga amounted to 12,000 metric tons, which is the highest figure ever reached and indicates a possible yearly production of 144,000 metric tons. For the first five months of the year, the tonnage has amounted to 52,100, or 4,800 metric tons in excess of that for the corresponding period of 1928. It is, therefore, regarded as somewhat extraordinary that the shares of Tanganyika Concessions (which is mainly dependent upon Union Minière for its income) should be persistently offered from Brussels. The Americans who bought Tanganyika shares a year or so ago are now believed to be liquidating their holdings in "Tanks" through the Continent, to finance their commitments in Northern Rhodesian enterprises. In this connection Minerals Separation, which pays 25 per cent for 1928 as against 12½ per cent for the preceding twelve months, is confident that the copper ores being developed in Northern Rhodesia—whether they be sulphide, oxide, or mixed oxide-sulphide ores—will be readily amenable to treatment either by flotation or by the copper segregation process. This may be so, but the ammonia leaching process in operation at the Bwana M'Kubwa has certainly not been a success.

In view of the important position which copper occupies in the base-metal world, the progress of the Indian Copper Corporation is of interest. Smelting began November last, and in April 150 short tons of refined copper was produced. In the following month only 45 tons was produced, owing to the necessity for relining the refining furnace, a process which must be carried out about every four months, but as a second unit is practically completed, this decrease is not likely to be repeated. For the first two weeks of June, 97 tons of 99.54 per cent copper was produced. A large order has been secured from the Calcutta mint.

## Great Northern Iron Ore Reports Increased Earnings

Great Northern Iron Ore in its report for 1928 shows a substantial increase in earnings. Consolidated statement of income of the trust and the trustees' interest in the income of the proprietary companies during 1928 compares as follows:

| | 1928 | 1927 | 1926 | 1925 |
|---|---|---|---|---|
| Net royalty and ore sales | $4,239,888 | $2,968,809 | $2,893,918 | $2,814,920 |
| Interest, dividends and other income | 200,292 | 72,750 | 151,872 | 140,762 |
| Total income | $4,440,180 | $3,041,559 | $3,045,790 | $2,955,682 |
| Taxes | 596,719 | 366,467 | 445,366 | 468,068 |
| Miscellaneous expenses and losses | 155,759 | 145,697 | 248,106 | 246,440 |
| (a) Balance | $3,687,702 | $2,529,395 | $2,352,318 | $2,241,174 |
| (b) Salaries and expenses of trustees | 55,369 | 63,124 | 64,411 | 78,881 |
| Consolidated net income before depreciation | $3,632,333 | $2,466,271 | $2,287,907 | $2,162,293 |
| Dividends | 4,125,000 | 2,250,000 | 2,250,000 | 2,625,000 |
| Deficit | $492,667 | (c) $216,271 | (c) $37,907 | $462,707 |

(a) Trustees' interest in the net distributable income of proprietary companies. (b) Less interest and rentals. (c) Surplus.

Andes Copper reports net profit of $3,814,503, after depreciation and federal taxes, for the quarter ended March 31. Production in this period was 44,744,692 lb. of copper, extracted from 1,934,038 tons of sulphide and oxide ores treated. Receipts were $8,080,699.

## Castle-Trethewey Had $199,125 Net Profit in 1928

Castle-Trethewey Mines, Ltd., operating in Ontario, reports that despite the low price of silver prevailing in 1928, the year's profit was substantial and considerably better than that obtained in 1927. Operating statement for fiscal year ended March 31, 1929, follows:

**Revenue**

| | | |
|---|---|---|
| Silver and cobalt recoveries | $546,937 | |
| Interest earned and other miscellaneous income | 23,561 | $570,498 |

**Expenditures**

| | | |
|---|---|---|
| Operating Costs: | | |
| Development and mining | $212,137 | |
| Tramming and hoisting | 30,282 | |
| Milling | 54,101 | |
| Smelting, refining and shipping | 29,752 | |
| Other camp expenses | 2,272 | $328,546 |
| Administrative and General Costs: | | |
| Management and general expenses at mine | $15,572 | |
| Corporate, legal, transfer and administration — Toronto office expenses | 15,145 | |
| Insurance | 4,808 | |
| Municipal taxes and rentals | 706 | 36,232 |
| | | 364,779 |
| Operating profit for year before providing for depreciation and taxes | | $205,719 |
| Reserved for Dominion income taxes | | 6,593 |
| Net profit for year (subject to depreciation) carried to surplus account | | $199,125 |

The company reports that during the period under review, the tonnage milled was increased, the grade of ore was maintained and the unit cost of production reduced. Production totaled 951,718 oz. silver and 40,339 lb. cobalt.

Chile Copper and subsidiaries report net profit of $9,453,691 for the quarter ended March 31, after depreciation, interest, and federal taxes. This compares with $3,172,766 in the corresponding quarter of 1928. Total receipts were $16,830,199. In this period, 3,229,638 tons of 1.642 per cent copper ore was treated and 93,485,659 lb. of copper produced.

West End Consolidated has proposed to stockholders that the corporation be reorganized with a capitalization of $1,000,000, of which $600,000 would be used to liquidate indebtedness and provide a development fund. Stockholders would receive one share of new stock for five shares of the old issue. The management states that extensive areas in the West End and Mabel properties invite exploration, but that the company is not in a position to do this work.

## An Analysis of Michigan Copper Production in 1928

ACCORDING to F. C. Pardee, Michigan state mine appraiser, copper production of the state in 1928 was distributed as follows:

| | Pounds |
|---|---|
| Calumet & Hecla Consolidated Copper | |
| Conglomerate mine | 34,933,000 |
| Osceola amygdaloid | 18,318,000 |
| Kearsarge amygdaloid | 38,057,000 |
| Calumet reclamation | 22,437,000 |
| Tamarack reclamation | 7,459,000 |
| Copper Range Company | |
| Champion mine | 19,563,535 |
| Baltic mine | 3,415,082 |
| Trimountain mine | 1,275,515 |
| Isle Royale Copper Company | 10,520,771 |
| Mohawk Mining Company | 21,243,265 |
| Quincy Mining Company | 1,220,536 |
| Total | 178,442,704 |

General facts pertaining to the industry in 1928 are summarized as follows:

| | |
|---|---|
| Copper ore treated (includes reclamations), tons | 7,361,658 |
| Copper produced, lb. | 178,442,704 |
| Copper produced per ton of ore treated, lb. | 24.239 |
| Average price received for sale of copper, less transporation charges, cents per lb. | 14.3105 |
| Gross value of copper produced less transporation charges | $25,536,043 |
| Number of days worked | 309 |
| Tons per man per day | 3.359 |

Production in 1929 seems likely to exceed the output of 1928 by a substantial margin.

The average cost per pound of producing Michigan copper in 1928 is summarized in detail in the following table:

| | Cost in Cents per Pound | | | |
|---|---|---|---|---|
| | Mines Only | | Mines and Reclamation | |
| General expense | | | | |
| General property tax | 0.4849 | | 0.4896 | |
| State corporation tax | 0.0459 | | 0.0451 | |
| Depreciation | 1.3436 | | 1.3264 | |
| General office | 0.1174 | | 0.1142 | |
| Other general expense | 0.537 | | 0.5046 | |
| Total | 2.5291 | 2.5291 | 2.4799 | 2.4799 |
| Mining cost | | | | |
| Labor | 4.5002 | | 3.9608 | |
| Supplies | 2.4533 | | 2.4763 | |
| Total | 6.9535 | 6.9535 | 6.4371 | 6.4371 |
| Treatment cost | | | | |
| Transporation (ore to mill) | 0.3628 | | 0.3021 | |
| Concentrating | 1.0539 | | 0.8774 | |
| Transportation to smelter | 0.0435 | | 0.0377 | |
| Smelting and refining | 0.6983 | | 0.6972 | |
| Total | 2.1585 | 2.1585 | 1.9144 | 1.9144 |
| Selling and delivery expense | | 0.4369 | | 0.4304 |
| Total gross cost | | 12.0780 | | 11.2618 |
| Average price received for copper | | 14.7555 | | 14.7409 |
| Average profit | | 2.6775 | | 3.4791 |
| Other costs | | | | |
| Construction and installation of equipment | 0.4962 | | 0.5246 | |
| Income tax | 0.4496 | | 0.4179 | |

### E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

| | |
|---|---|
| 1920 | 130.92 |
| 1921 | 80.80 |
| 1922 | 93.94 |
| 1923 | 103.43 |
| 1924 | 102.63 |
| 1925 | 111.74 |
| 1926 | 107.74 |
| 1927 | 97.54 |
| 1928 | 99.78 |

| | 1927 | 1928 | 1929 |
|---|---|---|---|
| January | 100.46 | 97.54 | 106.86 |
| February | 100.01 | 96.73 | 110.37 |
| March | 100.84 | 96.22 | 122.71 |
| April | 98.63 | 97.14 | 116.36 |
| May | 96.41 | 99.05 | 110.03 |
| June | 95.55 | 100.16 | 109.66 |
| July | 95.42 | 99.69 | ..... |
| August | 97.25 | 99.85 | ..... |
| September | 96.01 | 100.53 | ..... |
| October | 95.36 | 102.34 | ..... |
| November | 96.22 | 103.83 | ..... |
| December | 98.30 | 104.28 | ..... |

NORTH TAIPING TIN DREDGING, operating near Penang, Malay States, increased output from 358 tons of tin to 431 tons in 1928, but profits increased only from £37,317 to £37,648, because of the decline in the price of the metal. Ground treated totaled 930,000 cu.yd. and working costs were 4.13d. per cubic yard. As a result of the exhaustion of the richer areas of ground, the dredge is being dismantled for re-erection at Belau, where 160 acres of ground have been drilled. An estimated total of 6,700,000 cu.yd. of gravel has been proved there, which will be available for dredge operations.

BURMA CORPORATION reports a net profit of 422,385 for its operations during the quarter ended March 31 at the Bawdwin mine, in Burma. The total revenue during this period was £946,777 and operating expenses were £524,392. A total of 117,997 tons of ore was extracted. Refinery producton was 19,610 tons of refined lead and 1,838,394 oz. of silver. Production of copper matte was 2,400 tons, assaying 54 oz. of silver, 28 per cent lead, and 40 per cent copper. Zinc concentrate produced amounted to 14,620 tons, assaying 51 per cent zinc, 5.45 per cent lead, and 9 oz. of silver to the ton.

LUIRI GOLD AREAS, LTD., operating in Northern Rhodesia, presents the following statement of accounts for the period ended Dec. 31, 1928:

| | | |
|---|---|---|
| Purchase consideration of mining rights | | £30,000 |
| Matala Hill Mine development | | 6,073 |
| Expenditure on other properties | | 3,574 |
| Expenditure in Rhodesia on treatment of ore | £ 1,609 | |
| Add depreciation | 650 | |
| | 2,259 | |
| Less value of gold recovered | 204 | 2,054 |
| London office expenditure | 1,091 | |
| Less interest received | 265 | 826 |
| Buildings and plant at cost | 13,003 | |
| Less depreciation | 650 | 12,353 |
| Stores | | 2,486 |
| | | 57,370 |
| Preliminary expenses | | 850 |
| Underwriting commission | | 6,250 |
| Gold in hand | | 204 |
| Debtors | | 391 |
| Cash at bank and in hand | | 28 |
| | | £65,096 |
| Capital authorized and issued— | | |
| 120,000 priority shares of 5s. each | £30,000 | |
| 120,000 ordinary shares of 5s. each | 30,000 | |
| | | £60,000 |
| Creditors | | 5,096 |
| | | £65,096 |

## Current Statistics of Production and Stocks of Copper, Lead, and Zinc

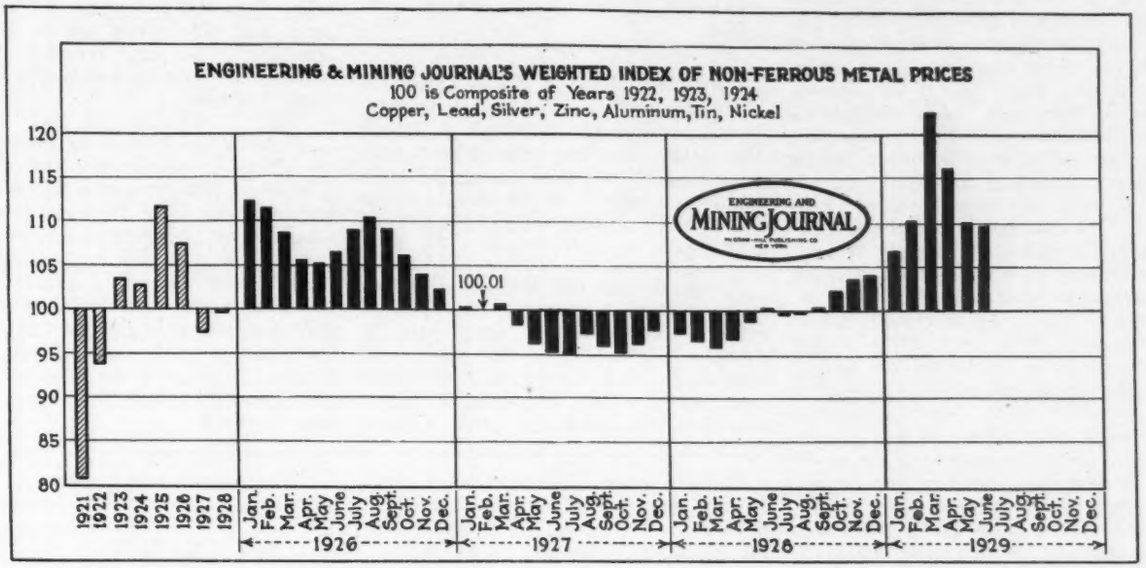
Data from American Bureau of Metal Statistics

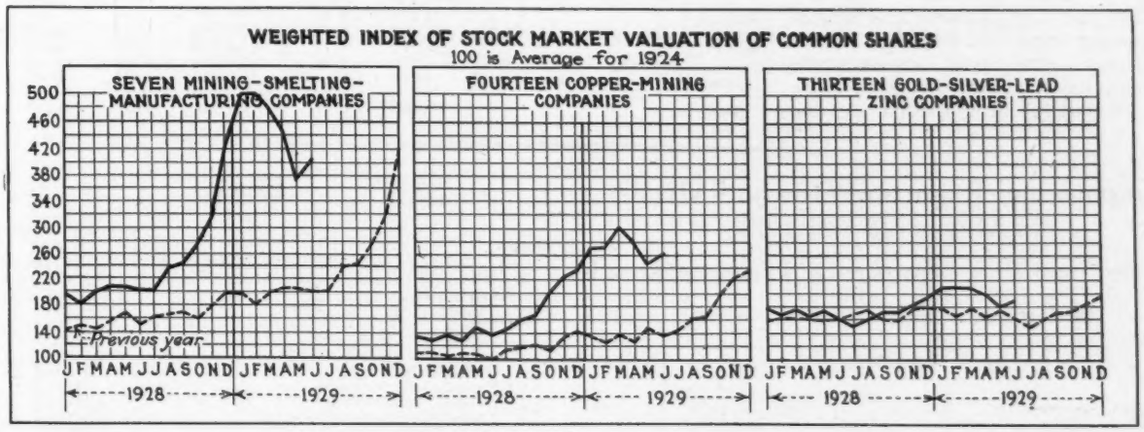
*Figures Represent Short Tons*

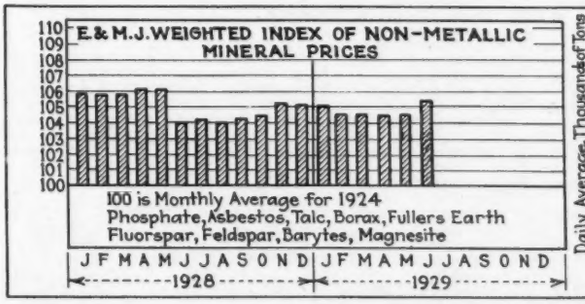
| | 1927 | 1928 | | | | | | | 1929 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COPPER—North and South America** | Average | Jan. | Feb. | March | April | May | Dec. | Average | Jan. | Feb. | March | April | May |
| Production, refined, daily average | 4,045 | 3,959 | 4,305 | 4,160 | 4,094 | 4,169 | 4,771 | 4,448 | 4,983 | 5,049 | 5,276 | 5,378 | 5,219 |
| Domestic shipments | 68,737 | 64,824 | 73,789 | 72,642 | 72,234 | 79,103 | 84,889 | 81,955 | 100,135 | 98,771 | 105,860 | 99,051 | 93,743 |
| Foreign shipments | 53,489 | 56,721 | 60,603 | 55,970 | 64,989 | 56,738 | 49,703 | 57,185 | 57,054 | 50,150 | 59,946 | 57,708 | 55,123 |
| Stocks, blister and refined | 335,311 | 318,137 | 318,161 | 313,408 | 291,985 | 291,743 | 315,461 | 300,771 | 307,959 | 296,298 | 295,309 | 311,996 | 331,655 |
| **LEAD—United States and Mexico** | | | | | | | | | | | | | |
| Production, smelter, daily average | 2,513 | 2,479 | 2,630 | 2,608 | 2,208 | 2,345 | 2,700 | 2,514 | 2,656 | 2,559 | 2,617 | 2,720 | 2,675 |
| Production, U. S. mines, daily average | 1,798 | 1,755 | 1,896 | 1,872 | 1,671 | 1,661 | 1,846 | 1,785 | 1,891 | 1,723 | 2,118 | 2,083 | 2,067 |
| Imports into U. S. A. | 13,451 | 10,418 | 8,574 | 12,556 | 10,314 | 12,439 | 16,767 | 12,757 | 22,924 | 9,551 | 8,383 | 7,115 | ..... |
| Stocks, smelter and refinery | 156,878 | 157,417 | 167,692 | 173,411 | 161,207 | 159,375 | 161,460 | 160,511 | 156,182 | 160,597 | 158,683 | 156,888 | 162,155 |
| **ZINC—United States** | | | | | | | | | | | | | |
| Production, daily average | 1,681 | 1,691 | 1,726 | 1,803 | 1,783 | 1,723 | 1,632 | 1,693 | 1,604 | 1,720 | 1,790 | 1,822 | 1,837 |
| Domestic deliveries | 45,811 | 45,771 | 46,754 | 51,856 | 46,517 | 49,818 | 49,625 | 48,301 | 47,677 | 51,057 | 56,267 | 56,558 | 56,614 |
| Exports, slab zinc | 3,468 | 4,644 | 2,125 | 2,558 | 2,620 | 2,148 | (a) | (a) | (a) | (a) | (a) | (a) | ..... |
| Exports, ores and dross | 4,424 | 2,444 | 890 | 1,898 | 155 | 361 | 587 | 453 | 545 | 165 | 483 | 308 | 358 |
| Stocks | 37,602 | 42,163 | 41,290 | 41,529 | 44,759 | 45,225 | 45,441 | 44,333 | 45,418 | 40,620 | 37,962 | 34,588 | 33,826 |
| **World Production Rate (Daily Average)** | | | | | | | | | | | | | |
| Copper | 4,543 | 4,631 | 5,088 | 4,769 | 4,881 | 5,046 | 5,782 | 5,236 | 5,767 | 5,968 | 6,219 | 6,561 | 6,229 |
| Lead | 4,514 | 4,859 | 5,067 | 5,158 | 4,868 | 4,774 | 5,265 | 4,976 | 5,037 | 5,068 | 5,176 | 5,418 | 5,310 |
| Zinc | 3,910 | 4,179 | 4,285 | 4,394 | 4,352 | 4,248 | 4,426 | 4,271 | 4,231 | 4,357 | 4,448 | 4,537 | 4,528 |

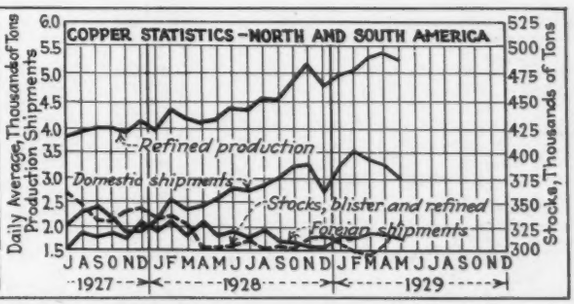
(a) Withheld pending investigation of government reports.

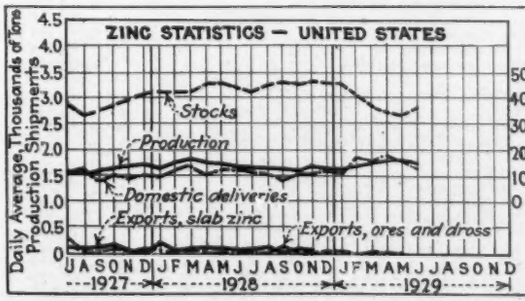
# *E. & M. J.* Statistics of the Mining Industries

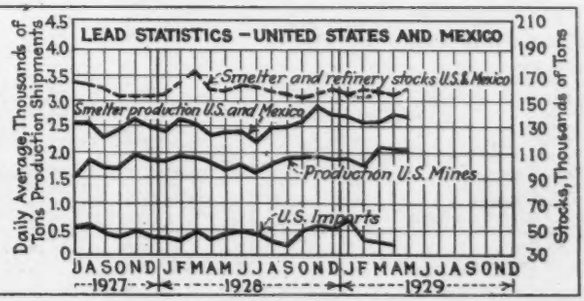




E.& M.J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate, Asbestos, Talc, Borax, Fullers Earth
Fluorspar, Feldspar, Barytes, Magnesite
1928
1929



## European Aluminum Cartel May Cut Price

ONE of the outstanding features of the European aluminum cartel has been the principle of gradually lowering the prices of its product. By a series of significant price cuts it has demonstrated its conviction of the advisability of this principle. At present, however, this policy is causing dissension within the group, according to a foreign trade note of the U. S. Department of Commerce. The Continental members, especially the Germans, are strongly in favor of continuing it; but England is ready to discontinue price lowering. The recent rise in the price of copper, which was followed by a very active copper market, has given stimulus to the British claim that aluminum would also benefit from a rise in price. The Continental group holds that because of the advance in copper prices an augmentation in the price of aluminum would be inadvisable, as it would prevent present users of copper from turning to the use of aluminum.

The outcome of this controversy is undoubtedly of considerable importance to the entire aluminum industry. Whether the disagreement has caused any serious results as yet could not be determined. The cartel is continually extending its scope, Italy being the scene of its greatest recent expansion. All the Italian output was disposed of in Italy, and the cartel is apparently well satisfied with both production and sales in that country. Affiliated Spanish works are much hampered by political difficulties.

—◆—

CHILEAN NITRATE PRODUCTION in May amounted to 276,000 metric tons, as compared with 262,000 tons during May, 1928. Exports were 150,000 tons, as against 147,000 tons during the same month last year. World stocks at the end of May are reported to be 1,623,400 metric tons.

ANACONDA COPPER MINING directors have declared a quarterly dividend of $1.75 to stockholders of record July 13, payable Aug. 19, or at the rate of $7 annually. This is the first dividend since the company increased its capitalization by absorbing Chile Copper stock on the basis of 73 Anaconda shares for 100 Chile shares and by selling additional stock to shareholders on the basis of two shares for every five held. Previous to this increase the company had also been on a $7 basis annually. The total number of Anaconda shares now outstanding is roughly about 7,500,000.

TAIPING TIN DREDGING, operating in the Malay States, increased its profits to £19,910 in 1928, despite a decline in the price of tin. This increase was made possible by stepping up production. Total yield was 439 tons of fine tin, from 1,840,000 cu.yd. of gravel treated. Working costs were 4.03d. per cubic yard treated, as compared with 4.01d. last year. At the annual meeting, D. A. Brown, chairman of the company, stated that 33 acres of additional ground had been acquired.

CONSOLIDATED COPPERMINES CORPORATION reports distribution of total production in 1928 from its properties in the Ely district, Nevada, as follows:

| Mine or place | Dry Tons | Per Cent Copper | Pounds Copper | Ounces Gold | Ounces Silver | Pounds Lead |
|---|---|---|---|---|---|---|
| Richard | 18,491 | 3.13 | 1,015,161 | 110 | 479 | ..... |
| Morris | 401,498 | 1.35 | 8,047,899 | 5,161 | 11,432 | ..... |
| Brooks | 226,073 | 1.12 | 4,243,910 | 2,906 | 6,437 | ..... |
| Ora | 314,371 | 1.50 | 8,244,299 | 4,460 | 15,162 | ..... |
| Leases | 1,054 | .... | 667 | 1,458 | 3,341 | 19,405 |
| Total | 961,487 | 1.39 | 21,551,936 | 14,097 | 36,853 | 19,405 |

The company reports that it is rapidly changing from a development to an operating basis. Output is now about 3,000 tons of ore daily.

## Imports and Exports of Ores and Metals in May, 1928 and 1929

Compiled from U. S. Department of Commerce Records

*In Pounds, Unless Otherwise Stated*

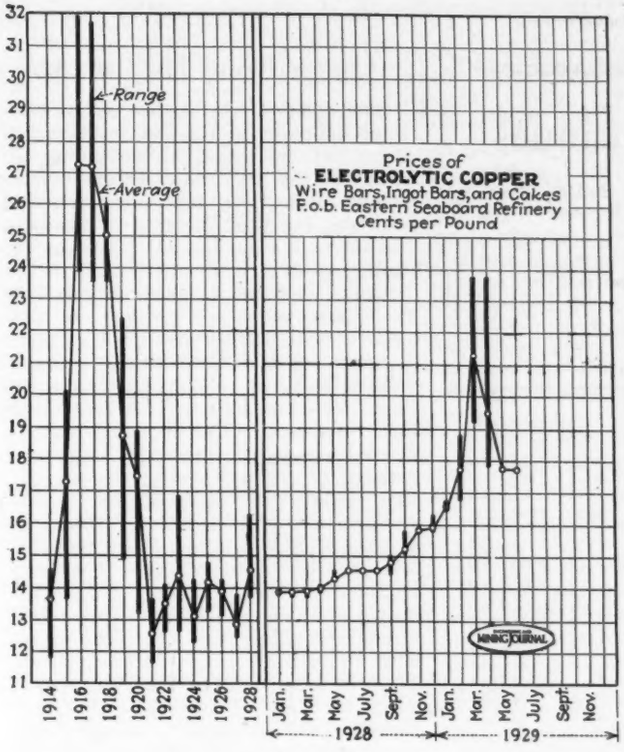
### Imports

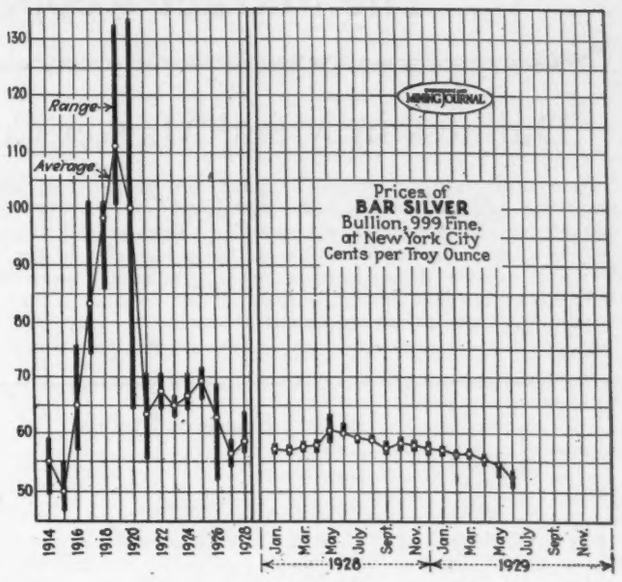
| | May 1928 | May 1929 |
|---|---|---|
| **Antimony** | | |
| Ore — Gross weight | 279,995 | 148,559 |
| Ore — Antimony content | 131,982 | 94,701 |
| **Copper** | | |
| Ores, copper content | 12,242,013 | 8,095,146 |
| Concentrates, copper content | 3,997,053 | 3,225,656 |
| Regulus, coarse metal, cement copper | 330,646 | 56,778 |
| Imported from: | | |
| Spain | 251,298 | 503,662 |
| Canada | 5,336,334 | 5,480,762 |
| Mexico | 4,293,572 | 165,568 |
| Cuba | 747,023 | 45,807 |
| Chile | 5,672,700 | 1,434,890 |
| Peru | 106,598 | 130,286 |
| Other countries | 162,187 | 379,949 |
| Unrefined converter copper in pigs, bars and other forms | 27,868,026 | 51,086,217 |
| Refined copper | 3,258,348 | 12,012,661 |
| Old and clippings | 447,839 | 903,723 |
| Composition metal | ..... | ..... |
| Brass, old, for remanufacture (Value) | $334,867 | $341,955 |
| **Lead** | | |
| Ore and matte, lead content | 3,628,624 | 2,324,573 |
| Bullion or base bullion | 21,192,811 | 9,435,410 |
| Pigs and bars, old, and scrap, lead content | 58,404 | 2,127,817 |
| Babbitt, solder, other forms — Lead content | 59,305 | 155,056 |
| Babbitt, solder, other forms — Gross weight | 126,925 | 279,454 |
| Type metal, antimonial lead — Lead content | 171,720 | 92,171 |
| Type metal, antimonial lead — Gross weight | 223,988 | 111,994 |
| **Manganese, tons** | | |
| Cuba, manganese content | 166 | 1,200 |
| Other countries, manganese content | 16,283 | 27,767 |
| **Pyrites, tons** | 33,161 | 28,402 |
| **Tin, ore, tons** | 7 | 4 |
| Bars, blocks, pigs | 15,781,538 | 19,939,674 |
| Imported from: | | |
| Netherlands | 1,457,130 | 1,461,104 |
| United Kingdom | 3,281,222 | 3,150,840 |
| British Malaya | 8,186,254 | 14,136,887 |
| Netherland East Indies | 56,000 | 23,707 |
| Hong Kong | 179,375 | 1,088,736 |
| Australia | 134,400 | 78,400 |
| Other countries | 2,487,157 | ..... |
| **Zinc** | | |
| Ore, zinc content — Free | 50,050 | ..... |
| Ore, zinc content — Dutiable | 205,700 | 5,371,613 |
| Blocks, pigs and other forms, old | 4,502 | ..... |

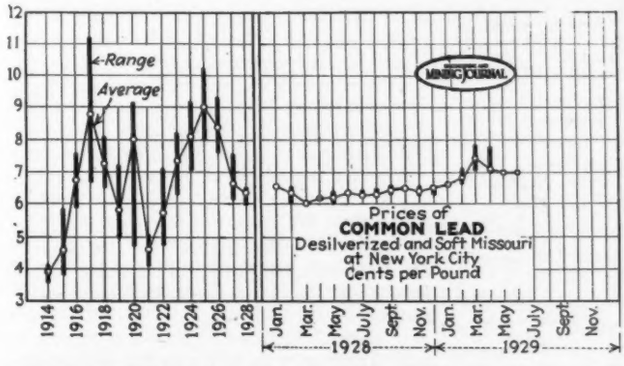
### Exports

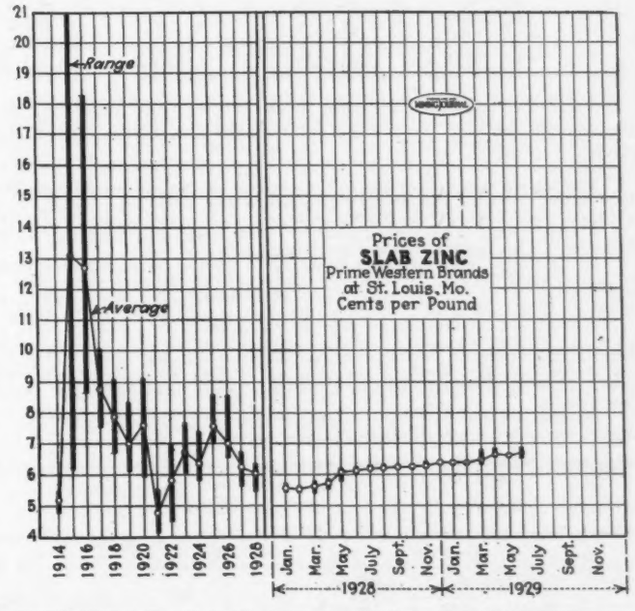
| | May 1928 | May 1929 |
|---|---|---|
| **Copper** | | |
| Ores, composition, concentrates, unrefined | 15,154 | 600 |
| Refined copper in ingots and other forms | 99,794,638 | 62,324,018 |
| Exported to: | | |
| Belgium | 9,657,791 | 3,455,443 |
| France | 20,442,789 | 9,941,185 |
| Germany | 17,519,553 | 16,316,788 |
| Italy | 9,662,010 | 7,339,331 |
| Netherlands | 7,573,882 | 3,341,049 |
| Spain | 593,912 | 33,533 |
| Sweden | 2,684,461 | 1,620,292 |
| United Kingdom | 15,693,576 | 11,418,419 |
| Other Europe | 7,708,120 | 291,832 |
| Canada | 1,880,755 | 5,290,950 |
| British India | 515,433 | ..... |
| China, Hong Kong, Kwantung | 1,097,600 | 1,099,300 |
| Japan | 4,534,812 | 1,231,722 |
| Other countries | 229,944 | 944,274 |
| Old and scrap | 4,813,765 | 2,373,655 |
| Pipes and tubes | 315,822 | 294,685 |
| Plates and sheets | 829,498 | 1,070,145 |
| Rods | 6,421,435 | 5,859,202 |
| Insulated copper wire and cable | 1,951,150 | 1,830,219 |
| **Lead** | | |
| In pigs, bars and other forms | 16,307,381 | 12,994,098 |
| From foreign ore | 14,720,119 | 7,757,325 |
| From domestic ore | 1,587,262 | 5,236,773 |
| Exported to: | | |
| Belgium | ..... | 448,178 |
| France | 392,092 | 309,237 |
| Germany | 3,607,593 | 418,106 |
| Netherlands | 840,173 | 358,524 |
| Sweden | 918,712 | 1,019,841 |
| United Kingdom | 6,162,137 | 6,050,155 |
| Other Europe | 505,141 | 1,221,183 |
| Brazil | 235,299 | 470,209 |
| Other South America | 247,770 | 176,349 |
| China, Hong Kong and Kwantung | 224,316 | 224,346 |
| Japan | 3,081,169 | 2,017,260 |
| Other countries | 92,979 | 280,710 |
| Other lead manufactures | 1,408,183 | 1,242,038 |
| **Zinc** | | |
| Ores and concentrates, ton | ..... | ..... |
| Dross | 708,840 | 713,230 |
| Cast in slabs, blocks and pigs | 4,296,391 | 1,602,653 |
| Exported to: | | |
| Belgium | ..... | 21,445 |
| France | 448,197 | 224,084 |
| Germany | 399,075 | 484,123 |
| Italy | 615,940 | ..... |
| Netherlands | 199,923 | 144,453 |
| United Kingdom | 110,741 | 224,020 |
| Other Europe | 618,303 | 167,995 |
| Japan | 1,735,387 | ..... |
| Other countries | 168,825 | 336,533 |
| Sheets, strips and other forms | 601,767 | 723,259 |
| Dust | 311,826 | 61,649 |
| Other zinc manufactures | 38,778 | 128,017 |

# Metal Price Curves

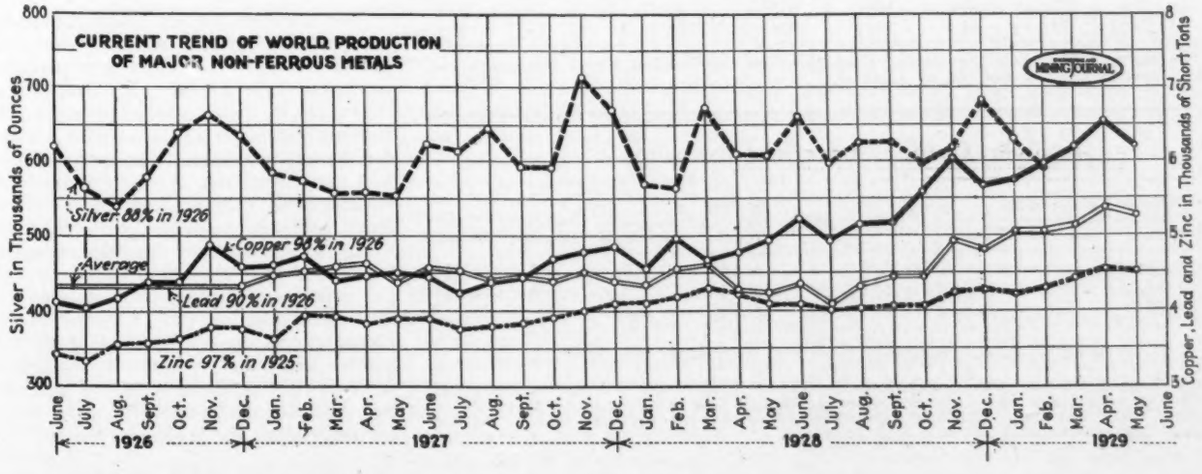



THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926, and accordingly the horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Silver in Thousands of Ounces
Copper, Lead and Zinc in Thousands of Short Tons
Silver 88% in 1926
Average
Copper 98% in 1926
Lead 90% in 1926
Zinc 97% in 1925
June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June
1926
1927
1928
1929

# The Market Report

## Dullness in Metal Market Continues

*New York, July 10, 1929*—The quietness that has characterized the metal markets for almost every week since the first of April shows no evidence of changing, in spite of the assertions made some weeks ago that buying, notably of copper, could not be postponed later than July 1. No great pressure to sell is yet in evidence, so that prices have continued firm, except for the slight declines in lead which were brought about principally by the weakness in London. Consumers seem to be waiting as long as possible before placing orders, and then buying only small quantities for immediate shipment. This gives the market a strong technical position and precludes the probability of price-cutting on any extensive scale unless metal stocks should become burdensome.

### Daily Prices of Metals

| July | Electrolytic Copper | Straits Tin | Lead | | Zinc |
|---|---|---|---|---|---|
| | Refinery | New York | New York | St. Louis | St. Louis |
| 4 | Holiday | ..... | .... | ..... | ..... |
| 5 | 17.775 | 45.00 | 6.90 | 6.70@6.725 | 6.70@6.80 |
| 6 | 17.775 | 45.125 | 6.90 | 6.70 | 6.70@6.80 |
| 8 | 17.775 | 45.125 | 6.90 | 6.70 | 6.70@6.80 |
| 9 | 17.775 | 45.125 | 6.90 | 6.70 | 6.70@6.80 |
| 10 | 17.775 | 45.625 | 6.80 | 6.60 | 6.70@6.80 |
| | 17.775 | 45.200 | 6.880 | 6.683 | 6.750 |

Average prices for calendar week ending July 6, 1929, are: Copper, 17.775; Straits tin, 44.925; New York lead, 6.960; St. Louis lead, 6.763; zinc, 6.730; and silver, 51.950.

**The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.**

**Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.**

**In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.**

**Quotations for copper are for the ordinary forms of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.**

**Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.**

**Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.**

### London

| July | Copper | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | Standard | | Electrolytic bid | Spot | 3M | Spot | 3M | Spot | 3M |
| | Spot | 3M | | | | | | | |
| 4 | 72 1/2 | 72 3/8 | 84 | 204 | 207 | 22 11/16 | 22 3/8 | 25 7/16 | 25 3/8 |
| 5 | 71 7/8 | 72 7/16 | 84 | 204 1/4 | 207 5/8 | 22 1/2 | 22 13/16 | 25 7/16 | 25 3/8 |
| 8 | 72 7/16 | 73 | 84 | 204 1/2 | 207 5/8 | 22 13/16 | 22 7/16 | 25 1/2 | 25 7/16 |
| 9 | 72 1/4 | 72 3/4 | 84 | 204 1/2 | 207 3/4 | 23 1/16 | 23 1/8 | 25 7/8 | 25 3/4 |
| 10 | 71 11/16 | 72 3/8 | 84 | 205 1/2 | 208 3/4 | 22 13/16 | 23 | 25 3/4 | 25 7/8 |

**The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.**

### Silver, Gold, and Sterling Exchange

| July | Sterling Exchange "Checks" | Silver | | Gold London | July | Sterling Exchange "Checks" | Silver | | Gold London |
|---|---|---|---|---|---|---|---|---|---|
| | | New York | London | | | | New York | London | |
| 4 | Holiday | .... | 24 1/16 | 84s11 1/2d | 8 | 4.84 3/8 | 52 1/4 | 24 3/16 | 84s11 1/2d |
| 5 | 4.84 3/8 | 51 7/8 | 24 1/16 | 84s11 1/2d | 9 | 4.84 3/8 | 52 | 24 1/16 | 84s10 1/2d |
| 6 | 4.84 3/8 | 52 1/4 | 24 3/16 | ..... | 10 | 4.84 1/2 | 52 1/8 | 24 1/8 | 84s11d |

Average: Silver, 52.100c.; Sterling Exchange, 484.475c.

**New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.**

### Copper Firmly Held at 18c.

The ranks of the copper sellers continue unbroken at the 18c. level, nor is there any indication of weakening, in spite of the fact that domestic sales rarely reach 5,000 tons per week and that the expected increase in business has been disappointing. The custom smelters continue to do most all of the business, but the large producers are not losing much by passing up such opportunities as they may have, so there is no ill feeling. Considerable speculation is heard as to why manufacturers have not come into the market, either here or abroad. The principal reasons offered are that an unusually large percentage of scrap is being cleaned up; that sellers of manufactured goods containing copper had larger stocks to dispose of than was generally thought, and that the ultimate buyer has been inclined to hold off hoping for a price drop; and that substitution of other metals and alloys may have been somewhat more of a factor than supposed. The vacation season also has some effect, the Hawthorne works of Western Electric, for example, closing down completely for two weeks to give all employees a vacation at once. Certain it is that the present quiet demand must soon end, even though it be not terminated by any huge buying wave.

Three-quarters of the demand this last week has been for prompt or July shipment, and only one lot as large as 500 tons has been sold. Foreign sales yesterday were good, but the market abroad quieted down considerably today, and unless business improves in the last two-thirds of the month, the total will be less than in June. The price continues at 18.30c., c.i.f. usual European ports.

Copper statistics for June are awaited with interest. It is generally expected that refined stocks are likely to increase by something like 25,000 tons, but that production will register a substantial decrease.

### Lead Price Reduced 1/4c.

Two price reductions featured the lead market in the last week. The first decline—from 7 to 6.90c. per pound—came on July 5 and was directly attributable to the continued weakness in London lead quotations. The second decline—from 6.90 to 6.75c. per pound—was announced late this afternoon by a reduction of that amount in the New York contract price of the A. S. & R. Company. Lack of domestic demand forced the price reduction today, though the continued uncertainty exhibited by lead quotations on the London Metal Exchange is the indirect cause of the entire situation. Volume of domestic sales in the last week was the smallest that has been reported in some time. Virtually all of the business reported has

been in the form of carload lots for prompt shipment.

Quotations in the St. Louis market have lagged somewhat behind those in the New York market, though the differential of 0.20c. per pound has existed in general throughout the period. On July 5, sales were reported at 6.75 and 6.725c. per pound, though a larger tonnage changed hands at 6.70c. per pound. Virtually all of today's business was placed on the basis of 6.60c. late this afternoon.

In the New York market a small tonnage was booked this morning at 6.90c. though the bulk of the contract sales of the larger producers will be booked on the 6.75c. price, as a result of which the actual weighted average for the day is closer to the lower level.

## But Little Zinc Sold

The zinc situation is entirely unchanged except that demand has not nearly equaled even the modest sales of last week. Many producers continue to adhere to the 6.80c. level, selling an occasional small lot, but other sellers have difficulty in awakening interest with quotations of 6.70c. All the business has been for prompt shipment. June sales of Prime Western reported by the American Zinc Institute totaled 10,546 tons at a weighted average price of 6.682c., comparing with the *E.&M.J.* average of 6.686c.

## Tin Advances

Prices for spot Straits tin were relatively steady during the greater part of the week until today, when combined consumer and speculative demand forced an advance of ½c. per pound—to 45⅝c.—for spot Straits. A somewhat mixed condition is reported by the various dealers, some reporting active business and others finding the market extremely quiet. Part of today's price advance appears to have resulted from speculative anticipation of the results to be achieved at tomorrow's meeting of producers in London; a tendency of consumers to buy for forward deliveries was noted also. Certain trade factors look for a further advance in prices.

## Silver Quiet and Steady

During the last week the silver market has been quiet and only unimportant fluctuations in price have taken place. Moderate buying by China and occasional orders from India have absorbed the small offerings in the local market, and the undertone appears steady at the present level.

*Mexican Dollars* (old Mexican pesos): July 4th, holiday; 5th, 39⅜c.; 6th and 8th, 39¾c.; 9th, 39½c.; 10th, 39⅝c.

## Foreign Exchange

Closing cable quotations on the principal foreign exchanges on Tuesday, July 9, 1929, were: Francs, 3.91$\frac{13}{16}$c.; lire, 5.23$\frac{7}{32}$c.; and marks, 23.82½c. Canadian dollars, $\frac{1}{32}$ of 1 per cent discount.

## Other Metals

**Quotations cover large wholesale lots unless otherwise specified**

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 8¼c. per lb. for all positions. Cookson's "C" grade, spot, 14c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 80@95c. Active demand.

IRIDIUM — Per oz., $230@$240 for 98@99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, $68 per oz. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $120@$121. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of July 6.

## Metallic Ores

TUNGSTEN ORE—Per unit of $WO_3$, N. Y.: Wolframite, $15.50@$16 for future delivery; Western scheelite, $18.50, for October and November delivery. Bolivian scheelite available at $15.50@$16 for near by.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the July 6 issue.

## Zinc Ore Stocks Lowered

*Joplin, Mo., July 6, 1929*

| Blende | Per Ton |
|---|---|
| High | $46.60 |
| Premium blende, basis 60 per cent zinc | $44.00@ 45.00 |
| Prime Western, basis 60 per cent zinc | 43.00@ 44.00 |
| Table concentrates, 60 per cent zinc | 41.00@ 43.00 |
| Flotation concentrates, 60 per cent zinc | 39.00@ 41.00 |
| Average settling price, all zinc ore | 44.30 |
| **Galena** | |
| High | $93.70 |
| Basis 80 per cent lead | 90.00 |
| Average settling price, all lead | 91.28 |

Shipments for the week: Blende, 13,102 tons; lead, 2,443 tons. Value all ore the week, $803,440.

A production restricted to around 6,400 tons and a shipment of 13,100 tons of zinc ore this week took 6,700 tons from the reserve stock in the bins. Purchases of zinc ore this week aggregated a tonnage sufficient to provide a shipment approximating 13,000 tons next week.

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*Platteville, Wis., July 7, 1929*

| Zinc Blende | Per Ton |
|---|---|
| Blende, basis 60 per cent zinc | $46.75 |
| **Lead Ore** | |
| Lead, basis 80 per cent | $90.00 |

Shipments for the week: Blende, 759 tons; lead, 40 tons. Shipments for the year: Blende, 18,210; lead, 980 tons. Shipments for the week to separating plants, 1,267 tons blende.

## Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the July 6 issue.

## Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, Sodium Nitrate, and Zinc Oxide are unchanged from prices in the July 6 issue.

## Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained 75@80 per cent W, $1.35@$1.45 f.o.b. works. Market firm.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the July 6 issue.

## Rolled Metals

Copper, Lead, Zinc, Monel Metal, and Nickel Sheets are unchanged from prices in the July 6 issue.

## Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of July 6.

## Iron, Steel and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $35@$36; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.75@$2.85. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

# Mining Stocks—Week Ended July 6, 1929

| Stock | Exch. | High | Low | Last | | Last Div. |
|---|---|---|---|---|---|---|
| **COPPER** | | | | | | |
| Anaconda, new | New York | 119¼ | 115½ | 117¾ | Jl. 13, Au. 19 | Q 1.75 |
| Andes Copper | New York | 54¼ | 52½ | 52½ | Jl. 13, Au. 12 | Q 0.75 |
| Arizona Com | Boston | 3 | 3 | 3 | Ja. 16, Ja. 31 | S.A. 0.25 |
| Calumet & Ariz. | New York | 131¼ | 129½ | 131½ | My. 31, Je. 17 | Q 2.50 |
| Calumet & Hecla | Boston | 43½ | 42¼ | 42¾ | My. 31, Je. 29 | Q 1.00 |
| Cerro de Pasco | New York | 100½ | 98 | 99¼ | Jl. 11, Au. 1 | Q 1.50 |
| Con. Coppermines | N. Y. Curb | 12⅛ | 11⅛ | 12 | | |
| Copper Range | Boston | 22¼ | 21½ | 22½ | Je. 15, Jl. 15 | Q 0.50 |
| East Butte | Boston | 3 | 2½ | 2½ | Dec., 1919 | 0.50 |
| Granby Con | New York | 82¼ | 78¼ | 82½ | Jl. 12, Au. 1 | Q 1.75 |
| Greene Cananea | New York | 179 | 170¼ | 176¼ | Je. 6, Jl. 1 | Q 2.00 |
| Howe Sound | New York | 71¼ | 66 | 70¼ | Je. 29, Jl. 15 | Q 1.50 |
| Hudson Bay | N. Y. Curb | 17⅛ | 16½ | 17 | | |
| Inspiration | New York | 47¼ | 45½ | 45¾ | Je. 13, Jl. 1 | Q 1.00 |
| Isle Royale | Boston | 22½ | 21⅜ | 22 | My. 31, Je. 29 | 0.50 |
| Kennecott | New York | 93½ | 86⅛ | 92¾ | My. 31, Jl. 1 | Q 1.25 |
| Magma Copper | New York | 70 | 68 | 68½ | Je. 28, Jl. 15 | Q 1.25 |
| Mason Valley | N. Y. Curb | 1¼ | 1¼ | 1¼ | | |
| Miami Copper | New York | 44½ | 43 | 43½ | Au. 1, Au. 15 | Q 1.00 |
| Mohawk | Boston | 55⅞ | 54¼ | 55½ | Ap. 30, Je. 1 | Q 1.50 |
| Mother Lode | New York | 3⅜ | 3⅛ | 3⅛ | Je. 13, Je. 29 | 0.20 |
| Nevada Con | New York | 48¼ | 46⅛ | 47⅛ | Je. 14, Je. 29 | Q 0.75 |
| Noranda | N. Y. Curb | 61¼ | 57⅛ | 61⅛ | | |
| Ohio Copper | N. Y. Curb | 2 | 1⅛ | 1⅛ | Sept., 1926 | 0.03 |
| Old Dominion | Boston | 10 | 9½ | 10 | Dec., 1918 | 1.00 |
| Phelps Dodge | New York | 65⅜ | 60 | 64½ | Je. 4, Jl. 1 | Q 0.75 |
| Quincy | Boston | 37½ | 35½ | 35½ | March, 1920 | 1.00 |
| Roan Antelope | N. Y. Curb | 46⅛ | 45¼ | 46⅛ | | |
| St. Mary's M. L. | Boston | 37½ | 37 | 37½ | Fe. 25, Mr. 12 | 2.00 |
| Seneca Copper | New York | 5¼ | 5¼ | 5¼ | | |
| Shattuck Denn | N. Y. Curb | 17⅛ | 17⅛ | 17⅛ | | |
| Sherritt-Gordon | Toronto | 8.00 | 7.60 | 7.90 | | |
| Tenn. C. & C. | New York | 18⅛ | 17⅛ | 18 | Au. 31, Se. 16 | Q 0.25 |
| United Verde Ex. | N. Y. Curb | 17⅞ | 16⅛ | 17½ | Jl. 2, Au. 1 | Q 1.00 |
| Utah Copper | New York | 318 | 310 | 318 | Je. 14, Je. 29 | Q 4.00 |
| Waite-Ack.-Mont. | Toronto | 4.70 | 4.65 | 4.70 | | |
| Walker Mining | Salt Lake | 4.15 | 4.05 | 4.05 | | |
| Wenden Copper | N. Y. Curb | 1¼ | 1⅛ | 1⅛ | | |
| **LEAD, ZINC, SILVER** | | | | | | |
| Ahumada Lead | New York | 2⅛ | 1⅞ | 1⅞ | | |
| Amer. Z. L. & S. | New York | 28½ | 27 | 28 | May, 1917 | 1.00 |
| A. Z. L. & S., pfd. | New York | 96 | 94½ | 96 | Je. 14, Jl. 1 | 1.50 |
| Bunker Hill & S. | N. Y. Curb | 138 | 138 | 138 | Ap. 25, My. 6 | X 0.75 |
| Butte Cop. & Zn. | New York | 4⅜ | 4⅛ | 4⅛ | | |
| Butte Cop. Con. | Boston Curb | *50 | *30 | *50 | | |
| Butte & Sup. | New York | 7 | 6⅛ | 6⅛ | Je. 14, Je. 29 | Q 0.50 |
| Callahan Zn-Ld. | New York | 1⅞ | 1⅞ | 1⅞ | Dec., 1920 | 0.50 |
| Chief Consol. | Salt Lake | 3.25 | 3.20 | 3.25 | Fe. 1, 1928 | K 0.10 |
| Consol. Ld. & Zn. "A" | St. Louis | 13⅛ | 12⅛ | 12⅛ | Je. 20, Jl. 1 | Q 0.25 |
| Constitution | Spokane | *35 | *35 | *35 | | |
| Dayrock | Spokane | 3.25 | 3.00 | 3.25 | Je. 20, Je. 30 | 0.03 |
| Dickens Consol | Spokane | *4 | *3⅜ | *3⅜ | | |
| Eagle-Picher | Cincinnati | 18⅛ | 16⅞ | 18⅛ | Je. 30, Jl. 15 | Q 0.20 |
| Eagle-Pich., pfd. | Cincinnati | ... | ... | 102 | Je. 30, Jl. 15 | Q 1.50 |
| Erupcion | Boston Curb | ... | ... | *10 | Ja. 1, 1928 | Q 0.07½ |
| Eureka Bullion | Salt Lake | *90 | *80 | *90 | | |
| Eureka Lilly | Salt Lake | ... | ... | *33 | | |
| Eureka Standard | Salt Lake | ... | ... | 1.42½ | | |
| Evans-Wallower | N. Y. Curb | 19⅛ | 18 | 18⅞ | | |
| Evans-Wal., pfd. | N. Y. Curb | ... | ... | 84½ | Je. 20, Jl. 1 | Q 1.75 |
| Federal M. & S. | New York | ... | ... | 240 | Je., 1927 | 10.00 |
| Fed. M. & S., pfd. | New York | 102 | 100½ | 102 | My. 24, Je. 15 | Q 1.75 |
| Gladstone | Spokane | *9 | *8 | *8 | | |
| Golconda | Spokane | 1.07 | 1.01 | 1.03 | Je. 15, Jl. 1 | 0.02 |
| Grandview | Spokane | *41 | *40½ | *40½ | | |
| Hecla Mining | N. Y. Curb | 17½ | 17½ | 17½ | My. 15, Je. 15 | Q 0.25 |
| Highland-Surprise | Spokane | *12½ | *11 | *12 | | |
| Jack Waite | Spokane | *9½ | *8⅞ | *8⅞ | | |
| Kootenay Florence | Spokane | *14½ | *14½ | *14½ | | |
| Lucky Jim | Spokane | *11½ | *11 | *11 | | |
| Lucky Tiger-C. | Kansas City | †4.25 | †4.00 | .... | Jl. 5, Jl. 20 | 0.02½ |
| Mexican Premier | Spokane | 2.28 | 2.25 | 2.28 | | |
| National Lead | New York | 152½ | 149 | 152½ | Je. 14, Je. 29 | Q 1.25 |
| Natl. Lead, pfd. A | New York | 138½ | 138½ | 138½ | Mr. 1, Mr. 15 | Q 1.75 |
| Natl. Lead, pfd. B | New York | 119 | 118 | 118 | Jy. 19, Au 1 | Q 1.50 |
| N. J. Zinc, new | N. Y. Curb | 79¾ | 78 | 78½ | Jl. 20, An. 10 | Q 0.50 |
| New Quincy | Salt Lake | 2.27½ | 2.17½ | 2.17½ | My. 15, My. 27 | Q 0.10 |
| Noble Five | Spokane | *60 | *58 | *60 | | |
| North Lily | Salt Lake | 7.10 | 7.00 | 7.00 | Jan. 20 | Q 0.25 |
| Park Bingham | Salt Lake | 9.00 | 7.50 | 9.00 | | |
| Park Utah | New York | 7⅜ | 7⅛ | 7⅛ | Je. 14, Jl. 10 | Q 0.20 |
| Pend Oreille | Spokane | 6.25 | 5.00 | 5.00 | | |
| Rico Argentine | Salt Lake | *40 | *39½ | *39½ | No. 30, De. 15 | Q 0.03 |
| Ruth-Hope | Spokane | *38 | *38 | *38 | | |
| St. Joseph Lead | New York | 69¼ | 67½ | 67½ | Se. 10, Se. 20 | QX 0.75 |
| Sherman Lead | Spokane | *38 | *37½ | *37½ | | |
| Silver King Coa. | Salt Lake | ... | ... | 12.50 | Je. 20, Jl. 1 | 0.25 |
| Silversmith | Spokane | *11 | *10½ | *10½ | Oct., 1926 | Q 0.02 |
| Sunshine Mining | Spokane | 3.02 | 3.01 | 3.02 | Je. 10, Je. 20 | Q 0.05 |
| Tamarack-Custer | Spokane | *81 | *79 | *80 | Sept., 1924 | 0.25 |
| Tintic Standard | Salt Lake | 13.25 | 13.12½ | 13.12½ | Je. 17, Je. 29 | QX 0.30 |
| Tonopah Belmont | N. Y. Curb | ... | ... | *56½ | Oct., 1925 | 0.05 |
| Treadwell-Yukon | Toronto | 9.75 | 9.00 | 9.00 | | |
| United Zinc Smg. | N. Y. Curb | ... | ... | *68⅜ | | |
| Utah Apex | Boston | 3⅜ | 3⅜ | 3⅜ | May 15, June 1 | 0.25 |
| Utah Met. & Tun. | Boston | 1⅛ | 1 | 1⅛ | Dec., 1917 | 0.30 |
| Whitewater | Spokane | *88 | *80 | *80 | | |
| Yellow Pine | Los Angeles | .... | .... | *8 | Dec., 1925 | QX 0.04 |
| **GOLD** | | | | | | |
| Alaska Juneau | New York | 7 | 5⅞ | 6⅛ | | |
| Barry-Hollinger | Toronto | *29 | *27 | *28 | | |
| Central Manitoba | Toronto | *48 | *40 | *46 | | |
| Coniaurum | Toronto | *36 | *30 | *30 | | |
| Cresson Consol. | N. Y. Curb | *68¼ | *62¼ | *62¼ | Mr. 30, Ap. 10 | Q 0.02 |
| Dome Mines | New York | 9¼ | 9⅛ | 9⅛ | Jl. 20, | Q 0.25 |
| Golden Cycle | Col. Springs | †1.90 | †1.89 | .... | Fe. 15, Mr. 1 | 0.04 |
| Gold Hill | Toronto | .... | .... | *2½ | | |
| Hollinger | Toronto | 5.70 | 5.45 | 5.65 | Je. 28, Jl. 15 | FW 0.05 |
| Homestake | New York | 73 | 73 | 73 | My. 20, My. 25 | M 0.50 |
| Kirkland Lake | Toronto. | *88 | *85½ | *88 | | |
| Lake Shore | Toronto | 26.00 | 25.50 | 25.50 | Je. 1, Je. 15 | Q 0.20 |
| McIntyre-Porc. | New York | 15¼ | 15⅛ | 15⅛ | My. 1, Je. 1 | Q 0.25 |
| Portland | Colo. Springs | †*11 | †*10 | ..... | April, 1927 | 0.02 |
| Rand Mines | New York | .... | .... | 35 | Fe. 21, '28 | Am.Sh. 1.52 |
| Siscoe | Toronto | *64 | *56 | *59 | | |
| Sylvanite | Toronto | *91 | *85 | .90 | | |
| Teck-Hughes | Toronto | 8.75 | 8.50 | 8.55 | Jl. 18 | Au. 1 0.15 |
| Tom Reed | Los Angeles | *69 | *62 | *62 | Dec., 1926 | 0.02 |
| Unity Gold | N. Y. Curb | .... | .... | 1 | | |
| Vipond Consol | Toronto | *84 | *84 | *84 | April, 1927 | 0.03 |
| Wright-Hargreaves | Toronto | 1.75 | 1.65 | 1.68 | Oc. 16, No. 1 | 0.02½ |
| Yukon-Alaska | N. Y. Curb | .... | .... | 35⅛ | | |
| **GOLD AND SILVER** | | | | | | |
| Carnegie Metals | N. Y. Curb | 18⅛ | 18⅛ | 18⅛ | | |
| Castle-Trethewey | Toronto | *32 | *30 | *32 | | |
| Consol. Cortes | N. Y. Curb | .... | .... | *12½ | | |
| Dolores Esperanza | N. Y. Curb | .... | .... | *78 | July, 1923 | 0.05 |
| Keeley | Toronto | *45 | *43 | *43 | Mr. 15, 1928 | 0.04 |
| Mining Corp. | Toronto | 4.15 | 4.05 | 4.10 | My 30, Je. 13 | 0.12½ |
| Montana-Idaho | Spokane | *10 | *8⅛ | *8⅛ | | |
| N. Y. & Hond. Ros. | N. Y. Curb | 16½ | 16½ | 16½ | Ap. 17, Ap. 27 | QX 0.05 |
| Nipissing | N. Y. Curb | 2⅛ | 2⅛ | 2⅛ | Je. 29, Jl. 20 | Q 0.07½ |
| Premier Gold | N. Y. Curb | 1¼ | 1⅛ | 1⅛ | Je. 13, Jl. 3 | Q 0.06 |
| Tonopah Exten. | N. Y. Curb | .... | .... | *10 | April, 1925 | 0.05 |
| Tonopah Mining | N. Y. Curb | 3⅛ | 3⅛ | 3⅛ | Ap. 7, Ap. 20 | 0.07½ |
| United Eastern | N. Y. Curb | *62½ | *37½ | *62½ | | |
| Yukon Gold | N. Y. Curb | .... | .... | *62½ | June, 1918 | 0.02 |
| **IRON AND STEEL** | | | | | | |
| Bethlehem Steel | New York | 114¾ | 111 | 111½ | Jl. 19, Au. 15 | Q 1.00 |
| Beth. Steel, pfd, 7%. | New York | 119 | 117½ | 117½ | Je. 1, Jl. 1 | Q 1.75 |
| Cleveland-Cliffs | Cleveland | 99 | 97½ | 97½ | Je. 6, Je. 15 | 5.00 |
| Colo. Fuel & Iron | New York | 66¼ | 62½ | 65 | | |
| Colo. F. & I., 1st pfd. | New York | ... | ... | 78 | My. 10, My. 25 | Q 2.00 |
| Great Northern Iron. | New York | 29½ | 28½ | 29¼ | Dec. 15, | K 2.00 |
| Inland Steel | New York | 94½ | 90 | 91½ | My. 15, Jn. 1 | Q 0.87½ |
| Republic I. & S. | New York | 107⅝ | 100½ | 100½ | My. 11, Je. 1 | Q 1.00 |
| Republic I. & S., pfd. | New York | 110⅛ | 109½ | 110⅛ | Je .12, Jl. 1, | Q 1.75 |
| Sloss-Sheffield S. & I. | New York | 59½ | 58½ | 59½ | Mr. 11, Mr. 20 | Q 1.50 |
| Sloss-Sheff. S. & I., pfd. | New York | 86 | 86 | 86 | Je. 20, Jl. 1, | Q 1.75 |
| U. S. Steel | New York | 200 | 189½ | 196⅜ | | |
| U. S. Steel, pfd. | New York | 140¼ | 139¼ | 140½ | My. 4, My 29, | Q 1.75 |
| Virginia I. C. & C. | New York | 23 | 23 | 23 | Jan., 1924 | 1.50 |
| Virginia I.C. & C., pfd. | New York | .... | .... | 45 | Jl. 16, 1928 | SA 2.50 |
| **MISCELLANEOUS** | | | | | | |
| Aluminum Co. of Am. | N. Y. Curb | 355 | 288 | 355 | | |
| Alum. Co. of Amer., pf. | N. Y. Curb | 106 | 106 | 106 | Mr. 15, Ap. 1, | Q 1.50 |
| American Metal | New York | 66¼ | 63½ | 65 | Au. 21, Se. 1 | Q 0.75 |
| Amer. Metal, pfd., 6% | New York | 120½ | 120½ | 120½ | Au. 21, Se. 3 | Q 1.50 |
| Amer. Sm. & Ref. | New York | 112¾ | 109¾ | 110½ | Je. 30, Jl. 12 | Q 1.00 |
| Amer. & Sm. Ref., pfd. | New York | 134 | 133½ | 134 | Au. 3, Se. 1 | Q 1.75 |
| Ang. Ch. Nitrate | N. Y. Curb | 39¼ | 34¼ | 35 | | |
| Asbestos Corp. | Montreal | 12 | 10 | 11 | Jan. 1926 | 1.50 |
| Asbestos Corp., pfd. | Montreal | .... | .... | 31½ | De. 31, Ja. 15 | Q 1.75 |
| Consol. M. & S. | Montreal | 404 | 401 | 404 | Je. 29, Jl. 15, | SA X 6.25 |
| De Beers Consol. | New York | .... | .... | 23 | Ja. 19, Ja. 26, | 0.48 |
| Federated Metals | N. Y. Curb | 35 | 34 | 35 | Je. 25, Jl. 5 | Q 0.75 |
| Freeport Texas | New York | 48 | 46 | 46½ | Jl. 5, Au. 1 | Q 1.00 |
| Int. Nickel Can. | New York | 52¾ | 50¾ | 51¾ | Je. 1, Je. 29 | Q 0.20 |
| Int. Nickel, pfd. | New York | .... | .... | 121 | Jl. 1, Au. 1 | Q 1.75 |
| Mayflower Assoc. | N. Y. Curb | 73 | 71 | 72½ | | |
| Metal & Mining | N. Y. Curb | 22⅜ | 20½ | 20½ | Je. 20, Jl. 1 | Q 0.30 |
| Newmont | N. Y. Curb | 216¾ | 197 | 214 | Je. 29, Jl. 15 | Q 1.00 |
| Patiño M. & E. | New York | 38½ | 35 | 38 | My. 31, Jn. 28 | 4s |
| So. America G. & P. | N. Y. Curb | .... | .... | 2½ | | |
| Texas Gulf Sulphur | New York | 75½ | 70 | 74½ | Je. 1, Je. 15 | Q 1.00 |
| U. S. Sm. R. & M. | New York | 61½ | 57⅜ | 58 | Jl. 5, Jl. 15 | Q 0.87½ |
| U. S. Sm. R. & M., pfd. | New York | 54¾ | 54¾ | 54¾ | Jl. 5, Jl. 15 | Q 0.87½ |
| Vanadium Corp. | New York | 92¼ | 88⅛ | 89⅛ | Fe. 1, Fe. 15 | Q 0.75 |

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

## LONDON QUOTATIONS—WEEK ENDED June 24, 1929

| | High | Low | Last | Date | Amount |
|---|---|---|---|---|---|
| Alaska Mexican ($5) | 20/— | 20/— | 20/— | | |
| Alaska Treadwell (25) | 60/— | 60/— | 60/— | Nov., 1926 | 4 p.c.(d) |
| Aramayo Mines (25 frs.) | 60/— | 58/1½ | 60/— | May 1929 | 5 p.c.(†) |
| Burma Corp (10 rupees) | 19/3½ | 18/9 | 19/1½ | July 1929 | 9 annas* |
| Bwana M'Kubwa (5s) | 21/— | 19/10½ | 20/— | | |
| Camp Bird (2s) | 2/4½ | 2/3 | 2/4½ | April, 1928 | 16⅔ p.c. |
| El Oro (£1) | 4/10½ | 4/9 | 4/10½ | Nov., 1924 | 2½ p.c.* |
| Frontino & Bolivia (£) | 8/7½ | 8/7½ | 8/7½ | Jan., 1929 | 3½ p.c. |
| Mexican Corpn. (£1) | 15/9 | 14/— | 15/6 | | |
| Mexico Mines of El Oro (£1) | 7/10½ | 6/3½ | 6/3 | Dec., 1926 | 3½ p.c.* |
| Mount Isa (£1) | 45/— | 42/6 | 44/4½ | | |
| N'Changa Copper Mining. (£1) | 83/9 | 73/9 | 76/3 | | |
| Oroville Dredging (4s) | 1/6 | 1/6 | 1/6 | Nov., 1928 | 31½ p.c. |
| Rhodesian Congo Border (£1) | 189/4½ | 170/— | 172/6 | | |
| St. John del Rey (£1) | 17/— | 16/9 | 17/— | Apr., 1929 | 7½ p.c. |
| San Francisco Mines (10s) | 37/3 | 36/6 | 37/— | June 1929 | 15 p.c. |
| Santa Gertrudis (£1) | 11/1½ | 10/6 | 11/— | July 1929 | 7½ p.c. |
| Selukwe (2s. 6d.) | 5/4½ | 5/— | 5/— | April, 1917 | 6¼ p.c. |
| S. Amer. Copper (2s.) | 3/6 | 2/10½ | 3/3 | Nov. 1917 | 75 p.c. |
| Tanganyika (£1) | 60/— | 57/6 | 57/6 | July, 1928 | 5 p.c. |
| Union Miniere du Haut-Katanga (Brussels) | 10,850 | 10,800 | 10,810 | April, 1929 | 300.00 fr. |

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation. (d) U. S. Dollars.